THE THREE-DIMENSIONAL JIG-SAW PUZZLE:

A ceramic sequence from Northeast Thailand.

Rosemary A. Buchan.

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PREFACE

The ceramic material on which this research is based, was collected during test excavations at four sites inside Phu Wiang mountain in Northeast Thailand in February 1970, by an archaeological survey expedition consisting of staff and graduate students of the Universities of Hawaii and Otago, in liason with the Fine Arts Department of Thailand. Funds for the fieldwork were provided by the National Science Foundation of America, the Wenner-Gren Foundation, the Breezewood Foundation, and the New Zealand Universities' Grants Committee.

Excavations at the site of Non Nong Chik were supervised by Mr. R.H. Parker and Miss A. Stapleton of the University of Otago; those at Don Sawan by Mr. Pote Gueagoon of the Thai Fine Arts Department; those at Don Wat Kao by Miss M. Burke of the University of Hawaii, and those at Don Khok by Mr. Parker. The detailed notes made by these people in the field were of great value to me when dealing with pottery from the excavations.

I am grateful to the Royal Thai Government for allowing the excavated material to be taken out of the country for study. The Royal New Zealand Air Force transported the finds to New Zealand.

Samples for radio-carbon dating were processed by the Department of Scientific and Industrial Research, Wellington, New Zealand.

I would like to thank my joint supervisors, Dr. D.T. Bayard and R.H. Parker of the University of Otago for their interest and constructive criticism in all aspects of this work. Their firsthand knowledge of Southeast Asia and of the sites in question, proved particularly valuable.

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CHAPTER 1.

INTRODUCTION

The aims of this research are threefold - to demonstrate changes in the ceramic sequence of four sites in one area in Northeast Thailand; to assess the extent to which these changes are indicative of wider changes in the prehistoric culture responsible for them; and to compare ceramic changes in all four sites with a view to establishing a tentative overall sequence for the area in question.

Ceramic material has, in many parts of the world, long been regarded as a sensitive indicator of cultural change (Childe, 1952: 68; Beals & Hoijer, 1965: 361). Ceramic decoration is considered to be particularly appropriate in this respect, since decoration is more amenable to innovation than are pottery attributes more closely related to the manufacturing process, or to function, such as temper, paste, or form. The large number of potsherds which, because of their durability, is recovered from sites is

also an advantage in that large and meaningful samples may be obtained for study. At the same time, this weight of numbers may lead to an over-estimation of the significance of ceramics in a wider cultural context. The fact that pottery may constitute the majority, if not the totality, of artifacts in an excavation is often taken as sufficient justification in itself to warrant the establishment of culture sequences based primarily on ceramic styles (Childe, 1952: 102-147, Chang, 1964: 359, 368-375). In some cases, the preponderance of a ceramic form in related assemblages may result in the assignment to a culture of a misleading 'tag-name' derived from a major diagnostic artifact. For example, the discovery of distinctive beaker-shaped pottery vessels in barrow burials in Europe and the British Isles, led to the definition of several related 'Beaker cultures' (Childe, 1956: 124-125; Piggott, 1963: 54). The name tends to obscure the fact that this culture can also be defined on the basis of other equally significant artifact types. There is also a danger that diverse cultures may be classified as similar because of shared pottery types. It is clear that before any studies of pottery can be undertaken adequate consideration should be given to the exact nature of the relationship between ceramics and other cultural activities, with special emphasis on the extent to which changes in one may effect changes in the other.

In Southeast Asia, as in other areas of the

world, pottery has been considered part of a 'Neolithic complex', and its presence in an excavation has been taken to indicate the practice of agriculture, whether the latter has been positively identified as being present or not. Elsewhere, there are indications that pottery production and the utilisation of domesticated species of plants and animals are not necessarily associated. At some sites, there is evidence of prehistoric communities with an economy based on agriculture which did not make pottery. A notable example of this is afforded by the two pre-pottery Neolithic levels at Jericho (Kenyon, 1956: 188-189, 1959: 5-9). In other cases, pottery appears in sites in contexts where agriculture was apparently not practised, for example in some early Jomon sites in Japan (Kidder, 1959: 32). In Southeast Asia, the traditional Mesolithic/Neolithic division has been adhered to until quite recently. The presence of cord-marked earthenware sherds in the upper levels of some Hoabhinian sites, associated with a stone technology identified as typically 'Mesolithic' in configuration, has in most cases been explained as due to intrusions from Neolithic levels or from sites elsewhere (Colani, 1927; Tweedie 1953; Matthews 1964), although some pre-historians have considered the possibility that pottery-making was present in the Hoabinhian (Solheim, 1970: 151). However, the recent identification of possible incipient plant domestication,

along with polished stone tools and pottery, in a Hoabinhian context at Spirit Cave in North Thailand (Gorman, 1969a: 1970, 1971) may well indicate that possibly agriculture, and certainly pottery were indeed present in the Hoabinhian. It is clear that wherever primary indications of domestication have definitely been identified in sites in Southeast Asia, pottery has also been present. Whether the reverse is true is a little more difficult to determine. The lack of sophistication of early excavation techniques, and the concentration on more conspicuous artifact material, may in all probability have resulted in less obtrusive evidence for domestication (for example carbonised seeds, pollen grains) being ignored. In any case, the belief in a Neolithic period for Southeast Asia prompted the assumption that wherever pottery or polished stone tools were present, agriculture also occurred (van Heekeren and Knuth, 1967). However, most contemporary prehistorians working in the area would view the terms 'Mesolithic' and 'Neolithic' as having little or no meaning when applied to Southeast Asis (for example, Dunn, 1970: 1050-51). The use of more careful scientific techniques of analysis may, in the future, allow a more comprehensive examination of the relationship between ceramics and domestication.

In many Southeast Asian sites the introduction of metal-working has had an effect on ceramic styles. Although the imitation of metal forms in pottery common

elsewhere (Trachsler, 1965: 152-160) has not so far been found to occur in Southeast Asia, changes are nonetheless marked. This may in part be due to the expansion of trade networks associated with bronze manufacture, allowing a more ready diffusion of artifacts and ideas. The result is frequently the introduction of new elements into locally-made wares, or an increase in the number of non-local wares.

At a few sites, the beginning of metal-working is seemingly associated with evidence for the development of social stratification, resulting perhaps from an accumulation of wealth by some members of the society due to metal production, or to craft specialisation.

For example, in Middle Period 1 at Non Nok Tha in Northeastern Thailand, the presence of relatively large numbers of bronze implements and a florescence in bronze-casting is accompanied by a proliferation of local pottery styles, and by a limited amount of imported ware (Bayard, 1971: 132-138). Also present are a variety of burial practices suggesting the possible division of society along functional lines. At Ban Chiang, also in Northeast Thailand, the bronze-bearing level is marked by the appearance in quantity of a distinctive red-on-white painted ware which continues through the following iron-age level, and which is in marked contrast to the cord-marked, incised, or carved-paddle-impressed wares of the preceding 'Neolithic' level (Pote, 1973: pers. com.). On the

other hand, changes in pottery may not always tend towards superior quality or a variety of ceramic styles. Some, but not all of the pottery from the Bronze Age level at Sai Yok is described as inferior to that of the Neolithic level in workmanship and in variety. Along with some large cord-marked earthenware vessels, the presence of a group of coil-made, crudely-finished pots is notable. They are explained as being replicas of more sophisticated funerary ware intended for the graves of poorer elements of the society (van Heekeren and Knuth 1967). The implication is that some kind of social stratification presumably based on wealth was operative, although no more secure evidence for this was obtained. In addition the presence of similar vessels in the Neolithic levels as well would tend to cast doubt on the arguments for stratification in this case. Of course not everywhere is the introduction of metal accompanied by changes in ceramics. The mat- or cord-impressed pottery associated with the Dong Son bronzes, for example, appears to be a continuation of the early cord-marked tradition of Southeast Asia (Pearson, 1962). However, where changes in pottery do occur, they appear to differ from site to site, and perhaps between specific areas. No one trend can be delineated.

The association between ceramics and ritual practices is common in Southeast Asia. The inclusion of pottery vessels as grave goods in inhumation burials occurs throughout the area from the time of the earliest

post-Hoabinhian sites. Burial pottery is often indistinguishable from domestic ware and although in some cases considerable care seems to have been exercised in its manufacture, it is often difficult to determine whether any special funerary wares were produced. Secondary burials in pots are also common, particularly in island Southeast Asia (Solheim, 1961). The introduction of Buddhism in the first millennium A.D., had a profound effect on ritual practices, and consequently on pottery associated with them. Cremation replaced inhumation burial, and involved, as a rule, secondary burial in funerary urns.

The position of domestic pottery is more tenuous, since more data exists on prehistoric burial pottery than on prehistoric domestic wares. This is partly because more burial than habitation sites have been excavated, but also because it is difficult to identify pottery as domestic if it is not firmly associated with occupational evidence, whereas the presence of pots in burials makes their purpose quite clear. As well as this, burial pots are likely to remain relatively intact, enabling complete recovery, restoration, and study, while domestic pottery quickly becomes broken and scattered. Calder's study (1972) of breakage and subsequent distribution patterns in a modern Thai village is significant in this respect. In addition, there has often been inadequate stratigraphical analysis of sites where both burials and occupation occur at different periods.

The study of domestic pottery in ethnographic contexts can prove fruitful in considering its role in prehistoric cultures. In rural areas in modern Thailand, domestic pottery is associated with three activities related to food - cooking, storage, and consumption. To a large extent, the form of domestic pottery will be dictated by the requirements of these three activities. In Northeast Thailand, ceramic cooking vessels are made predominantly of earthenware, and tend to be squat and round-bottomed, with a wide mouth and a well-defined rim. Storage vessels, mainly of stoneware, are larger and deeper, with a flat bottom to allow them to stand steadily, and a more restricted mouth to prevent evaporation or contamination. Food is served in flat plates or bowls, some of earthenware, some of celadon or porcelain (Solheim, 1965 a; Calder, 1972: 99-128). Notable changes in any of these three activities may be reflected in changes in associated pottery, although not necessarily. Calder (1972: 53) states that in the village she studied, metal vessels have in the last generation replaced many ceramic forms for cooking, although this has not been the case with storage vessels used for drinking water, since the cheap earthenware or slightly more expensive stoneware vessels keep the water much cooler and are easier to obtain.

Contact with other areas is readily reflected in ceramics. In some cases, it may be possible to ascertain the nature of the contact: by transmission

of the actual artifacts through trade or population migration, through movement of craftsmen skilled in its manufacture, or by transmission of the idea only. Direction of the movement may be determined by secure dating.

The presence of obviously intrusive sherds amongst local wares are easily identifiable, and their origin may often be traced with a high degree of certainty. The occurrence in upper layers of Southeast Asian sites of finely-made ceramic wares produced by the Indianised Sukhothai and Ayuthia Empires and the Chinese Ming Dynasty is a notable example of this (for example, Solheim and Gorman, 1966). The small amounts in which these sherds occur may well indicate a limited trade in them as luxury items, rather than any influence of a more permanent kind. Certainly this is the case in modern Thailand, where fine Chinese and sometimes European imported wares are highly prized, and used only on ceremonial or other special occasions, while local wares are employed in everyday domestic activities (Calder, 1972: 55-56).

It is to be expected in general that a higher degree of outside influence will be reflected in ceramics as a higher proportion of non-local styles. The replacement of one ceramic inventory with another, especially if accompanied by parallel changes in other artifacts, would seem to suggest some form of population movement, or at least close contact of a comprehensive

nature. This situation is evident at the site of Chansen in central Thailand, where pottery wares of generalised Indian type, and later, those of the Funan Dvaravati Empires, replaced local wares and, along with innovations in other artifact forms, helped to define successive influences on an indigenous culture (Bronson n.d.).

On the other hand, similarities noted in only a single ceramic element probably signify the transmission of a ceramic idea by stimulus diffusion. The widespread occurrence of early cord-marked pottery in sites throughout Southeast Asia is one case in point. Also Solheim (1959) notes a similarity between decorative motifs on some Sa Huynh-Kalanay pottery and those found commonly on Dong Son bronze drums, at the same time pointing out that the pottery associated with the Dong Son bronzes bears no relationship to Sa Huynh-Kalanay pottery.

These, then, are briefly some of the ways in which ceramic material if used with caution can be used to demonstrate culture change. Ceramics represents only one item in the whole range of cultural products and as such relationships can be shown to exist between it and other artifacts to the extent that changes in one may be expected to correlate with changes in the other. Unless such a dynamic interrelationship can be shown to exist, however, the role of ceramics in reflecting other forms of cultural change must not be assumed. Change of a more comprehensive nature can only be shown through a

consideration of a wider range of artifact types.

As well as these theoretical problems, difficulties are also encountered on a practical level. In common with other cultural material ceramic artifacts require some form of classification to reduce their abundant quantity and variety of characteristics to a manageable form before it can be studied. The most common response to this need has been the construction of ceramic typologies.

The dependence on typology as the basis of much prehistoric analysis, can be seen in its widespread use. Archaeological types may be used solely as identificatory or descriptive devices (Black and Weer, 1936; Deetz, 1967), or may be employed to solve specific problems. The early belief in the similarity between archaeological and biological classification is apparent in the use of typologies at this time to demonstrate such things as industrial evolution, or the replacement of redundant forms by more suitable new ones (for example, Gorodzov, 1933). Later, a concern for the strict definition of archaeological entities led to the use of typologies to identify spatial units such as assemblage (Tugby, 1965: 8), component and culture (Rouse, 1960: 319), or as 'time-markers' in constructing chronological sequences (Steward, 1954: 54). Typology has been the basis of functional interpretations of cultural material which are then used in studies of culture history and cross-cultural comparisons (Steward, 1954: 56).

Of special significance to this research is the use made of typology in seriation methods for establishing chronological sequences. Seriation is based on the theory that artifact types come into being at a particular time and place, gain in popularity and therefore in number, and then decline, eventually to disappear (Brainerd, 1951: 304). The assumption is therefore that separate assemblages having the same relative frequency of occurrence of artifact types are comparatively contemporaneous. Long in use to aid the formation of chronological sequences, this method also contributes significantly to relative dating methods.

Early seriation methods, based on subjective judgements, were time-consuming and often inaccurate (Ford, 1962). However, the development of automatic methods of seriation, using numerical indices of similarity alleviated these difficulties to a certain extent. One of the first of these was devised by Robinson (1951) in conjunction with Brainerd (1951). Robinson noted that when a series of deposits was arranged in chronological order along the edges of a matrix, the arrangement of the similarity indices of their percentage type distributions within the matrix was such that the highest values occurred along the diagonal and became progressively smaller away from it. He extrapolated from this that the chronological order of a series of undated deposits could be obtained by arranging their indices in the matrix in a similar way. Subsequent applications of the method (Belous, 1953;

Dixon, 1956; Flanders, 1960), have proved essentially successful, although a certain amount of tedium is involved in the repetitive operations necessary for the ordering of the matrix. Ascher and Ascher's (1963) computer programme, written to enable this tedium to be avoided, was not proved wholly successful on subsequent investigation (Hole and Shaw, 1967: 68-69).

Two common criticisms of the Brainerd-Robinson technique are worthy of consideration. The belief that differences in sample size from deposits being compared will affect the validity of the results is not necessarily a well-founded one, unless the sample is altogether too small to be meaningful. Provided samples are of a reasonable size and are random and truly representative of the artifact population in question, no discrepancies should arise if minor differences occur. Dempsey and Baumhoff's (1963) criticism that great weight is given to types showing low relative frequency carry negligible weight is a well-founded one. Each artifact type must be able to contribute equally to the final result if it is to be 'meaningful'.

Other methods of automatic seriation, for example: Dempsey and Baumhoff's(1963) contextual analyses, or Meighan's (1959) triangular graph method have not been completely successful. The best method to date is the permutation search technique, adapted for computer by Hole and Shaw (1967: 13-24, 80-82). It involves the shuffling of a given matrix order by examining an

alternative set of orders until an improvement is made. This process may be repeated a number of times until the 'best' order is obtained. Computation of the matrix norms (sum of all the errors in the matrix) at each step allows a check to be kept on which order is most suitable, since a better order will have a lower matrix norm.

Seriation can be a valuable aid to prehistoric research if the limitations of the method are kept in mind. In general, the closer together the sites being studied in geographical space, the more likely the validity of similarities in frequency of occurrence. On the other hand, geographical contiguity does not necessarily imply similarity. Two distinct cultures may have existed in adjacent areas. Separate components of a single culture such as 'workshop' sites developed exclusively for the manufacture of tools, or temporary camps resulting from the exploitation of seasonal resources, will yield disparate combinations of types, as may areas within a single site where one particular activity was carried out. Calder (1972) demonstrated that in the village she studied in Northeast Thailand it was possible to archaeologically distinguish different rooms within one house by the distinct types of pottery found there.

Also to be taken into account is the assumption inherent in all seriation methods that the archaeological units being compared were in the past 'closed systems' with no influence from outside. No mechanisms exist in such studies for the inclusion of intrusive items, so that

these must be identified and separated from the data before seriation can be carried out.

At the basis of the method is another assumption that artifact types do exhibit a lenticular pattern of change and that this occurs at a steady rate. One recent investigation (McNutt, 1973) indicates this is not the case. It thus appears unlikely that changes do occur at an even rate, or in a lenticular pattern, given the number of other cultural phenomena which may influence them, and given the unpredictable nature of human activity, although some theorists would disagree (Clarke, 1968).

Seriation studies cannot be successful unless the typologies employed in the description of artifacts from each site are consistent. This may not always be the case, for while the basic definition of the type remains relatively constant, its composition may vary according to the purpose for which it is being used, or according to minor subjective differences on the part of the users.

Inherent in all definitions of the concept of 'type' is the idea of a minimal unit of human modification, commonly called an attribute but sometimes alternatively labelled, for example 'feature' (Krieger, 1944: 278), or 'trait' (Ehrich, 1950: 471). A recent work defines an attribute as a "basically irreducible character of two or more states acting as an independent variable within a specific frame of reference" (Clarke, 1968: 138).

In these terms, a type is defined as a group of artifacts consistently displaying a specific combination

of attributes sufficient to produce a characteristic form (Ehrich, 1950; Spaulding, 1960). The belief is that attributes making up a type are significantly associated with one another since they occur together in the majority of cases.

One dispute on the construction of typologies is centered on the question of whether attributes making up the type should be selected arbitrarily, with types being imposed on the data (Ford, 1954), or whether types are inherent in the data (Spaulding, 1953; Rouse, 1960). Exponents of the former opinion stress the necessity of flexibility of typology to allow for differing purposes and levels of analysis, while exponents of the latter advocate a careful search of the data to discover the pattern of attributes selected for by the makers. Statistical methods of establishing types are frequently employed in an effort to reduce subjective judgements (Spaulding, 1953, 1960).

Those who believe that a given set of data will yield only one typological classification - that which existed as an 'ideal' type in the society which produced it, are losing sight of the fact that ultimately typology is a tool, devised by the prehistorian to help solve specific problems, and as such, must be easily adaptable to the needs of differing interests. To conform to this need typology must represent an abstraction from reality (Childe, 1956: 4) and therefore be of necessity subjective. It is possible that given the same data, prehistorians

with differing aims could validly derive quite different typologies. Steward (1954) enumerates four kinds of types, defined on the basis of separate criteria, which can be employed in separate fields. Whether the researcher in selecting attributes to define a type should choose those presumably selected by the makers is irrelevant. What is important is that each typology should successfully fulfil the purpose for which it was intended. While variation in typologies is desirable on the level of formulation, parity in application must be achieved if they are to be used in comparative studies such as seriation.

Ceramics are less amenable to the imposition of simple typologies than most other forms of cultural material. The variety of ceramic attributes which renders some form of classification so necessary is the greatest hindrance to its successful completion. That attribute variety should be so great in ceramic artifacts is largely a function both of the material of which it is composed and its method of manufacture. The plastic nature of clay allows it to be shaped into a greater number of forms than would be possible with other materials such as stone, wood, or bone (Childe, 1956: 37). Also, unlike these other materials, the potter is able to vary the characteristics of the finished product by making additions to it with relative ease, in the form of such things as handles, lugs, rims, feet, or applique decorations. As mentioned previously, decorative styles,

and different types of surface finish free of the dictates of many technological considerations, are more amenable to the idiosyncrasies of individual preference. The end result is not only a greater variety of ceramic attributes, but also a lesser degree of necessary interdependence among component attributes of a ceramic artifact, so that repeated association of a specific attribute combination may not always occur.

Consequently, typologies imposed on ceramic material frequently result in a proliferation of ceramic types, so many in some cases that one of the major purposes of typology - that of reducing data to a manageable form - is not achieved. In some cases ceramic types may differ from one another only in quite minor respects, as for example in the classification of ceramic vessels and adzes at Ban Kao (Sørensen and Hatting, 1967; Parker, 1968).

One attempt to overcome these difficulties was the formulation of the 'type-variety' system of classification (Wheat, Gifford, and Wasley, 1958) and related discussion (Phillips, 1958; Sears, 1960). Central to this system is the idea of a 'ceramic type cluster' composed of one major type and several varieties of this type which differ from it in only a few minor characteristics. Each variety is also considered to differ from its parent type and other varieties in that it is distributed over a slightly different or more restricted area and time span. An application of the

method to the analysis of Maya ceramics (Smith, Willey and Gifford, 1960), was judged a success since the type variety classification was thought to approximate ceramic units in vogue amongst the population. Gifford (1960) makes explicit this criterion of success.

Although the 'type-variety' system represents an attempt to reduce the number of types resulting from ceramic classification, its value lies on a conceptual level only, where it may well be useful to the prehistorian to consider several interrelated classificatory units. On a practical level, however, one is still faced with the same number of these units whether they be called types, or varieties.

An added problem in respect to the data from Northeast Thailand is the difficulty in deriving a typology from ceramics composed primarily of non-reconstructable sherd material. Major diagnostic elements concomitant with complete pots - vessel form and dimension - are not available. For typological purposes, sherds should not be regarded as isolated entities but as components of the vessels of which they were once a part, to be considered in the context of the total characteristics of these vessels. The attributes of the pot it represents. It is possible that sherds from different areas on the one pot will display different combinations of attributes. Therefore, typologies emanating from sherd material alone are likely to be cumbersome, and often quite meaningless.

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In addition, preliminary investigation of a random sample of bags of potsherds from the four sites indicated the extreme variability of the ceramic attributes, to such an extent that a search for attribute associations to create a typology before the analysis commenced would have proved impracticable.

In view of this, and in the light of the drawbacks of ceramic typologies in general, it was thought more advantageous to consider ceramic change in terms of changes through time in individual attributes only. In this way, it would be possible to gain a more detailed insight into the way changes in the pottery occurred. At the same time, association between ceramic attributes, if present, would become clear as the study progressed, and could be tested later by statistical methods. From this, if possible, a ceramic typology could then be derived.

In order to facilitate the handling of such a large body of data, a computer was used to carry out analyses. In the last fifteen years, the computer has been used increasingly in prehistoric research to handle more efficiently operations which would be excessively time-consuming if carried out by hand. Two major contributions of computers to prehistory are in the organisation and reduction of data (Borko, ed. 1962), and its storage and retrieval (Chenhall, 1967; Cowgill, 1967). Related to the latter is the necessity of developing relevant codes by which data can be translated. Some consideration has been given to this issue (Gardin,

1967; Cowgill, 1967).

Computers have been employed to carry out analyses of data, and have proved useful in the outlining and testing of hypotheses. Much use has been made of computers to carry out statistical analyses. Programmes have been devised for chi-square and regression tests (Brown and Freeman, 1964), multiple regression (McPherron, 1963; Longacre, 1964), factor analysis (Binford and Binford, 1966), and proximity analysis (Hodson, Sneath and Doran, 1966).

The range of uses to which computers have been put to solve specific problems is wide. Cowgill (1968) used computer-aided calculations to help define discrete districts at the site of Teotihuacan, by using multivariate statistical techniques to isolate clusters of similar tracts at the site. Apart from Ascher and Ascher, Freeman (1962) has also adapted the Brainerd-Robinson seriation technique to the computer to establish chronological ordering of ceramics from six Pueblo sites in North America. Hole and Shaw (1967) have used a computer to evaluate various seriation techniques, and to plan one of their own. Computer programmes have been designed to test existing typological taxonomies (Clarke, 1962) or to produce new typologies (Sackett, Freeman and Brown, 1964; Federov-Davydov, 1966). They have been used to investigate the relationship between related assemblages (Issac, 1968), or to analyse functional variability therein (Binford and Binford, 1966). Other

uses have been the cataloguing of museum collections (Sweeney, 1969), site and artifact recording (Chenhall, 1969), and analysis for field recording (Newman, 1969; Midkiff, 1970).

While it is clear that the computer has immense potential as an aid to prehistoric research, it is important that it be employed only where appropriate. The initial novelty of the computer as a tool often led to its use in situations where it was not warranted. An evaluation of the validity of its use for specific purposes is necessary. It is also desirable that the researcher be able to understand the development of the particular programme he is using and have some knowledge of the operations it is performing.

CHAPTER 2.

PHYSICAL AND SOCIAL BACKGROUND AND EXCAVATION HISTORY

THAILAND

Modern Thailand occupies approximately 574,000 square kilometers of the Southeast Asian mainland between 6° and 21° N. Most of the country lies in Continental Southeast Asia, with a long strip extending down the eastern side of the Malay Peninsula to the border of the Federation of Malaysia. Thailand is bordered to the south by Cambodia and the Gulf of Thailand, to the east by Laos, and to the north and west by Burma.

It is a country of considerable ethnic variety. In 1960, the population numbered some 30.6 million, including approximately 20 million Thai, the dominant ethnic group, 3,500,000 Thai-Lao in the northeast, 160,000-400,000 Khmer concentrated in the southeast, 60,000 Mon, scattered throughout the country and over

2 million Tai Yuan in the north. Hill tribes in the north, comprising, 45,000 Meo, 25,000 Akha, 17,000 Lisu, 15,000 Lahu, 10,000 Yao, 7,000 Karen, and 2,000 Chaobon, contribute a significant number to the total population (United Nations, 1968: 92-94). It has been estimated that Chinese make up approximately 15% of the total population, and the Thai-Malays of the Peninsula approximately 3% (Pendleton, 1962: 3). Most of the population is rural. Only about 3 million Thai (approximately 10% of the total population) live in cities (United Nations, 1968: 89), whereas an estimated 85% make their living from agriculture (Pendleton, 1962: 63). Rice is the major crop and is grown throughout the country in upland swidden plots or in lowland padis. Rice is Thailand's major export, followed by rubber, teak and tin.

Topography also is characterised by variety. Two mountain chains, the Central Cordillera running north-south along the Burmese border and into the peninsula, and the Phetchabun range running parallel to it through the centre of the country enclose the rich alluvial lowlands of the Chao-Phraya valley. East of the Phetchabun Range is the vast expanse of the Khorat Plateau, consisting of a shallow layer of alluvium over rock. The Dang Raek Range runs east-west along the Thai-Cambodian border, and mountains comprise most of North Thailand.

Five river systems drain Thailand. The Mun and Chi rivers drain Northeast Thailand, and flow east to join the Mekong, which at that part of its course forms

border between Thailand and Laos. Central Thailand is drained by three rivers, all of which have their outlet in the Gulf of Thailand. The Chao-Phraya and its tributaries rise in the northern mountains and flow through the Central Valley and the Bangkok Plain further south, to the Gulf. To the east is the Prachin River which rises in the mountains along the Cambodian border, while to the west the Maeklong and its tributaries the Khwae Yai and the Khwae Noi flow out of the western mountains. Part of northwest Thailand drains into the Salween River which forms part of the Thai-Burmese border.

The geology of Thailand has recently been revised, (Department of Mineral Resources, 1969). Ordovician limestone of the Thung Song group overlies Cambrian deposits of the Tarutao group in the extreme northwest of the country and in the southern half of the peninsula. In places in the northwest, the Thung Song group is overlain by the lower formation of the Silurian-Devonian Tanaosi group - the Kanchanaburi formation of metamorphic and sedimentary rocks which also outcrops in the northeast, the southeast and the southern part of peninsular Thailand. The upper formation of the Tanaosi group, the Kaeng Krachan formation, occurs along the western side of the peninsula, in the north of Khorat along the Laotian border, and in the extreme north. The Tanaosi group is frequently overlain by Permian and Carboniferous limestone of the Ratburi group which is found extensively throughout the country. The Triassic

Lampang group is divided into two formations. Conglomerates of the Volcanic formation occur in the extreme south of the peninsula, while limestones of the Marine formation are found extensively in the north, with small outcrops in Khorat. Limestones, sandstones and conglomerates of the Khorat group which dates from the Triassic to the Cretaceous are found significantly in Khorat, but occur also in the north and in the peninsula. Tertiary shales and lignites of the Krabi group are found mainly in the north, with isolated outcrops in the south. Quaternary alluvium and river gravels are found throughout the country, particularly in the Chao-Phraya valley, throughout Khorat and the north, and on the eastern margins of peninsular Thailand. Apart from this sequence, volcanic deposits are found in many parts of Thailand. Pre-Permian gneiss and Carboniferous granite and mafic deposits overlie rocks of the Tanaosi group in the north and south. The Ratburi group is overlain in places by pre-Triassic porphyry in north and central Thailand, and by Triassic granite in the northwest, south, and west central Thailand where Cretaceous granite also occurs. Tertiary deposits of andesite, rhyolite, porphyry and tuff are found on the margins of Khorat and near the Central Plain.

For the most part, soils in Thailand are poor and infertile, except in river valleys and on some mountain slopes. Soils in the Central valley are mainly relatively fertile clays, with some loamy soils. Most Khorat soils are infertile loams. In the north, there are considerable

areas of clays and loams, although most of this area is covered by unclassified mountain soils (Pendleton, 1962: 83).

Thailand has a monsoon climate which may be separated into four distinct seasons. From March through until May, a season of high temperatures, relatively low humidity, and turbulent conditions ushers in the Southwest Monsoon which lasts from May until approximately September and establishes a pattern of heavy daily rainfall, with consequent high humidity and continuing high temperatures. From late September until November, a transitional season of decreasing rainfall and cooler temperatures ends in the Northeast Monsoon which usually lasts until February and is characterised by cool, dry, and frequently clear weather (Brown et al 1951: 13; Pendleton, 1962: 113-115; U.N., 1968: 5). While the seasonal monsoon climatic pattern is true for Thailand in general, local variations occur. Annual rainfall ranges from approximately 110 cm in the rainshadow areas east of the Phetchabun and Tenasserim ranges to well over 250 cm along the western edge of the Central Cordillera (Pendleton, 1962: 118; Royal Thai Survey Department Map, 1969). By far the most rain falls during the Southwest Monsoon. Annual average temperature for the whole of Thailand is 26° - 28°C. Temperatures on the Central Plain are slightly higher than average (28 - 30°), while north of latitude 17° N they are slightly lower, (24 - 26°C). On the whole, highest temperatures occur from December to May. Annual relative

humidity is 65 - 75% for the whole country (Royal Thai Survey Department Map, 1969).

The natural vegetation of Thailand is of the Monsoon Forest type, several varieties of which exist in specific localities. Evergreen rainforest covers most of the peninsula, the mountains and plains of the southeast coast, and the mountains around Khorat. Mixed pine and oak forest grows to a height of 1300 m on mountain slopes in northern and central Thailand. Mixed deciduous forest of the Moist Monsoon Forest type is found primarily in North Thailand, where commercially workable teak stands occur, while evergreen moist monsoon forest is found along the Maeklong and in coastal southeast Thailand. Moist monsoon forests contain a wide variety of tree species. Monsoon dry forests, consisting of only a few varieties of stunted trees, with bamboo undergrowth, are a result of adjustment to poor soils, low rainfall, and seasonal drought, and are found predominantly in rainshadow areas (Pendleton, 1962: 83-98).

Prior to the 1960's, little systematic prehistoric excavation took place in Southeast Asia. However, work done up until that time indicated that the area provided worthwhile opportunities for intensive research, despite the often inadequate nature of early site reports. From the beginning, pottery constituted a significant artifact class, in terms of volume at least, in most excavations. The following is a brief summary of some of the more important work that has been carried out in Thailand, and

of relevant research in Southeast Asia as a whole (see Figure 1).

In 1901, and again in 1923, Mansuy spent two seasons excavating the site of Samrong Sen, southeast of Lake Tonlé Sap in Cambodia. In its lower levels, the site contained polished stone tools with the addition in the upper levels of pottery and copper and bronze artifacts, although the presence of metal-working at the site was later disputed (Wörman, 1949). However, indications of a well-developed metal-working technology elsewhere in Cambodia came from three sites in close proximity to one another in the Mlu Prei region of North Central Cambodia, excavated in 1938 (Lévy, 1943). Levy's report provides stratigraphy for only one site, that of O Pie Can where a single cultural layer extending from 20 centimeters to 60 centimeters below the surface contained many pieces of bronze, a piece of the bottom of a crucible with adhering bronze slag, iron tools and slag, and sandstone moulds and fragments, as well as chipped and polished stone tools, and numerous plain and decorated sherds. Material from a surface collection and short-lived excavation at the O Yak site included numerous potsherds, quantities of bone and shell, and stone polishing tools, while surface collection at the O Nari site yielded polished stone tools, metal tools and potsherds.

Excavation of two sites, Dong Son in Vietnam (Goloubew, 1929, 1932; Karlgren, 1942, Janse, 1947, 1958), and Shih-chai Shan near Lake Tien in south China (von

Dewall, 1967), led to the definition of two related cultures, the Dong Son and Tien cultures respectively, based on similarities of bronze technology and decoration (Pearson, 1962; Chang, 1963). The pottery associated with the bronzes at both sites was hand-made locally, and in contrast to the bronzes was simply decorated with cord or mat impressions, simple painting, or incision.

Investigation by Colani of some 36 cave sites in the Hoa Binh region of North Vietnam (Colani, 1927, 1928, 1929, 1930), and those of Colani and Mansuy of a further twenty-seven sites in the Bacson region of the same country, revealed the existence of a number of related assemblages having as their characteristic artifacts tools flaked from river pebbles, with a small number of edge-ground tools and simple earthenware sherds in upper levels. Faunal remains indicated a hunting and gathering economy. The related assemblages were included together under the general term 'Hoabinhian' but the exact nature of the unit thus defined was not made explicit. Subsequent research has shown that assemblages similar to those found at the Hoa Binh and Bac Son sites are widespread in Southeast Asia. They occur at the site of Sai Yok in West Central Thailand, and other sites in the same area (Sørensen, 1962; van Heekeren, 1961, 1962), at Spirit Cave (Gorman, 1969, 1970) and Tham Nguang Chang (Watson, 1968; Loofs, 1970; Watson and Loofs, 1967), both in north Thailand, at Tham Hang in Laos (Fromaget, 1940), and

at the Malayan sites of Gua Cha (Sieveking, 1954), Gua Debu (Collings, 1936), Gol Ba'it (Tweedie, 1953) and Gua Kechil (Dunn, 1966). Boriskovski, (1962), has re-examined some of Colani's sites and investigated some others in the Hoa Binh region. Because of inadequate description of the Hoabinhian material by Colani, and in the light of subsequent discoveries, several redefinitions have been attempted (van Heekeren, 1957; Dunn, 1970; Matthews, 1966, Gorman, 1971).

The site of Sa huynh on the east coast of North Vietnam (Parmentier, 1924; Janse, 1961; Colani, 1939), yielded large quantities of pottery of two basic kinds and a variety of form; a red ware, and a thinner black ware. Typical decoration included cordmarking, incision, impression, and some painting; characteristic patterns were triangular designs, rectangular meanders, chevrons, and occasional triangular perforations on applied ring stands. The site gave its name to a pottery complex defined by Solheim as having widespread occurrence in Southeast Asia (Solheim, 1959). Particularly close relationship was noted between pottery from Sa-huynh and that from the Kalanay cave site on the east coast of Masbate, one of the Visayas Islands in the Philippines, excavated during the period 1951-1953. Decorative elements of the numerically dominant 'Kalanay brown' ware are incised running scrolls and triangular meanders, and closely parallel those at Sa-huynh. The more finely made 'Kalanay red' ware, comprising only one fifth of the total pottery found at the site, had typically a

'piecrust' decoration at the rim/body angle, and a crenellate design possibly impressed with the edge of a bivalve shell. Again in view of related pottery elsewhere in Southeast Asia, Solheim defined a Kalanay Pottery Complex (Solheim, 1957), and later a Sa-Huynh-Kalanay pottery tradition in Southeast Asia (Solheim, 1964a).

During the last fifteen years, the use of rigorous techniques of controlled excavation, the development of new scientific aids to analysis, and the recognition of the need for thorough site investigation recording and reporting have added a great deal to knowledge of the prehistory of Southeast Asia.

In 1957, a lengthy period of excavation began at the Great Cave of Niah in Borneo (Harrisson, 1957, 1959). Two discrete areas, a habitation area at the mouth of the cave and a burial area further back, provide a cultural sequence ranging from what Harrisson calls Early Stone Age (Harrisson, 1957, 1959) with a radiocarbon date of 38,000 B.C. associated with the lowest burial, through to European times (Harrisson, 1970). Pottery, mainly associated with the burials and showing a variety of forms, has been divided into five wares on the basis of decorative elements: plain, impressed: carved paddle, impressed: bound paddle, polished, and painted and incised, (Solheim, Harrisson and Wall, 1959).

During 1961 and 1962, a joint Thai-Danish expedition undertook a site survey of part of the Khwae Noi valley in western Thailand and discovered approximately twenty sites containing cultural material, most based on

early pebble tool cultures (Sørensen, 1962: 31-32). Five sites were isolated as worthy of further investigation. Extensive excavations were carried out at two of these sites: Sai Yok and Ban Kao.

The Sai Yok complex consisted of two caves and a terrace. A pebble-tool industry including choppers, Hoabinhian-like tools and micro-blades in association with bone and shell implements occupies much of the depth of the site. Material in the upper layers has been divided into typical Neolithic-characterised by a variety of sophisticated, handmade, predominantly cordmarked pottery, polished quadrangular and shouldered adzes, spindle whorls, and tools of bone - and Bronze age, including beads, bronze artifacts, and earthenware pots, some globular and cordmarked, some crudely coil-made. Historical material included Chinese ceramic wares, Buddhist bronzes, and iron tools (van Heekeren and Knuth, 1967).

The site of Ban Kao contained some 45 burials with grave goods of earthenware pots and polished stone adzes. Included in two of the burials were iron tools. Most of the pottery was cordmarked, although a considerable amount was burnished. Sørensen (1967) considers the material to be essentially Neolithic, and distinguishes two periods of Neolithic occupation, based on pottery types and categories of polished stone adzes. A radiocarbon date of 1770 $\pm$ 140 B.C. is attributed by the excavator to the early Neolithic level, and one of 1360 $\pm$ 140 B.C. to the late Neolithic level.

However, the validity of the pottery and adze classifications is doubtful (few categories were represented by more than one or two specimens), and the provenance of the radiocarbon samples has been called into question. In the light of this, a reinterpretation of the site has been made, postulating that it probably represents an iron age cemetery dug into an earlier Neolithic occupation (Parker, 1968). Moreover, a recent date from the site of 290 ± 255 B.C. (Bronson and Han, 1972) supports this view, and indicates that it may be far later than Sørensen suggests. A third site, Ongba Cave on the Khwae Yai River, although extensively disturbed by guano diggings, yielded evidence indicative of a long sequence of occupation. Finds included pebble tools of a Hoabinhian type, grinding stones, polished stone adzes and pottery, fragments of bronze, arm rings, pieces of bronze drums similar to those from Dong Son, and iron implements. The pottery found belonged to four wares - a black, burnished, wheel-turned ware of simple form with some sherds showing carination; dark cord- or mat-impressed handmade vessels with a pointed or round base, two sherds, probably imported, with red and black painted designs on a yellow slip, and a number of miniature vessels, crudely made by coiling, and predominantly cord or mat-impressed (Sørensen, 1962: 34).

In 1964, the discovery of a number of skeletons in the Artillery camp at Lopburi led to the excavation of the site by the Fine Arts Department of Thailand.

Historic remains, including Ming cups and numerous glazed sherds were encountered to a depth of 40 centimeters. In the ten centimeters immediately below this were discovered 36 Metal Age burials associated with mainly undecorated red and grey earthenware sherds, bone, stone and clay bracelets, bronze rings, iron tools, clay pellets and spindle whorls (Chin You-Di, 1965).

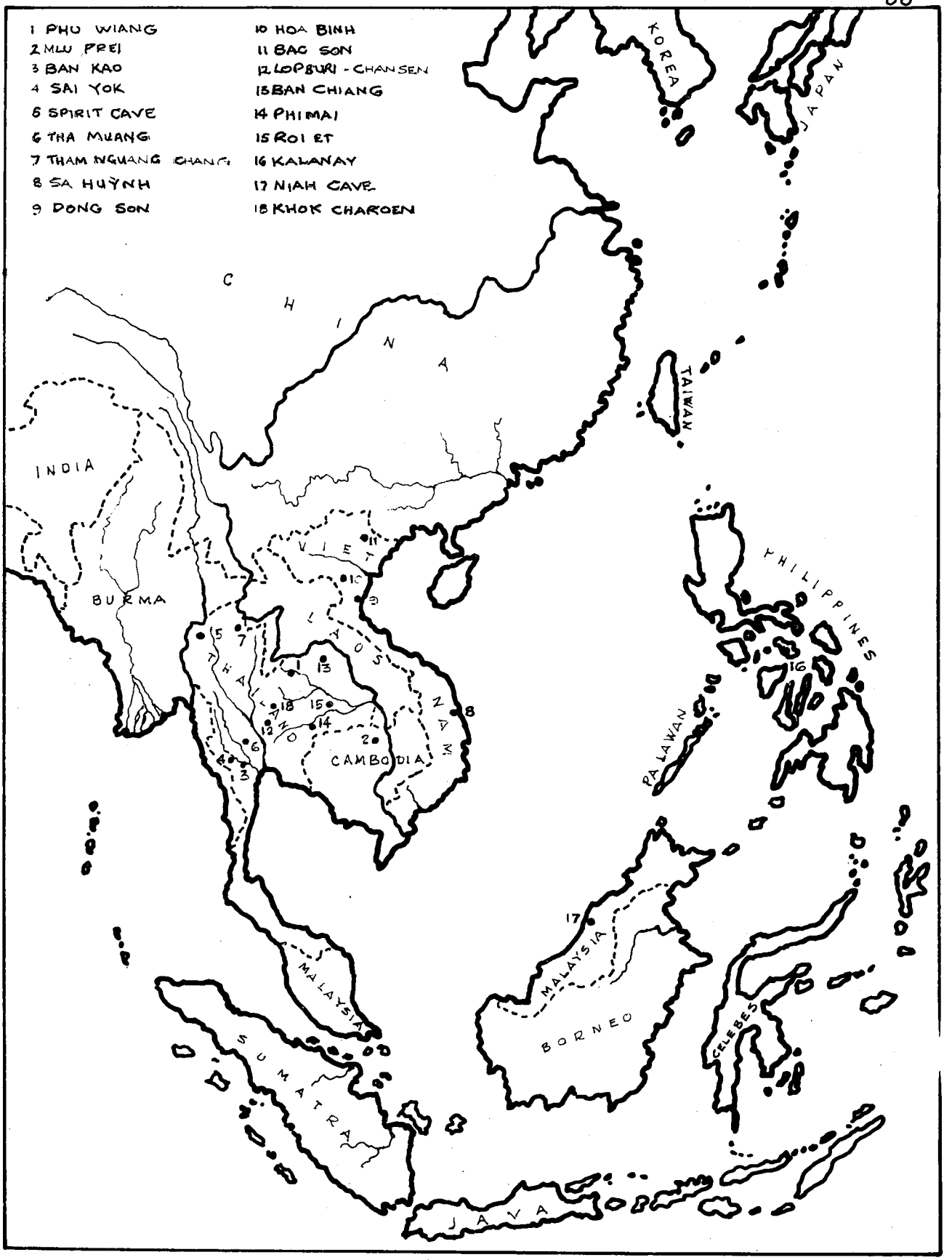
A joint Thai-British expedition spent two seasons in 1966 and 1967 investigating three sites in Thailand. At Khok Charoen a series of small mounds and low rolling hills in the northeast of Lopburi province three areas were excavated. That of Khok Charoen, number 3, prompted the identification of two groups of artifacts: a basal layer with pits dug into natural each containing a single pot buried upright, and second layer between 60 and 70 centimeters in depth in which were found 50 burials accompanied by handmade earthenware vessels, some of which had been deliberately smashed. A surface collection included small polished stone adzes, and a quantity of cordmarked stamped pottery. Two thermoluminescence dates have been obtained from the burial layer of 1180 $\pm$ 300 B.C. and 1080 $\pm$ 300 B.C. (Loofs & Watson, 1970: 77-78). Tham Nguang Chang is a cave site 18 kilometers north of Chiengmai in north Thailand. At the bottom of the site was a layer containing Hoabinhian-like tools, while the upper filling yielded three extended burials containing cordmarked pots, two iron chisels in one burial, and agate beads and

boar tusks in another. A bronze socketed axe was found in this upper layer. The third site to be excavated by the Thai-British expedition was Tha Muang in Suphanburi province. In the lower layer were found circles of large pits filled with burnt clay, probably eroded from disintegrating chedis in the vicinity, potsherds, and pieces of iron and bronze. They were identified tentatively as metal-working pits. Above this, successive layers of burnt clay and rubble indicated recurrent destruction of buildings on the site. Sherds of thin, black, poorly fired fragile ware encountered below 1.5 meters gave way to stoneware and coarse cordmarked earthenware in the upper layers (Watson, 1968; Loofs, 1970; Loofs and Watson, 1970).

In the spring of 1968 and 1969, a joint expedition by the National museum of Thailand and the University Museum of the University of Pennsylvania carried out excavations at the site of Chansen, in the province of Nakhon Sawan in Thailand, (Dales, 1968; Bronson, n.d.; Bronson and Dales, 1970). On the basis of excavated material and associated radiocarbon dates, and on integration with the traditional chronology devised by art historians, the occupation of the site was divided into six phases (Bronson, n.d.). The earliest inhabitants of the site (Phase I) are thought to have been indigenous wet-rice farmers using both bronze and iron, occupying a small village which gave evidence of initial Indian influence only after the beginning of the

present era. The village grew in size and complexity under the respective influences of the Funan and Dvaravati Empires, followed by a population decline between 800 and 1050 A.D. and eventual abandonment of the site. The earliest radiocarbon date from the site is from Phase II (incipient Indianisation) - 3 ± 42 A.D. and the latest from Phase V-973 ± 80 A.D.

Spirit Cave in north Thailand, excavated by Gorman (Gorman, 1969a and b, 1970, 1971) has provided significant discoveries for Southeast Asian prehistory. Gorman (1969a, 1970) divides the site's 5 layers into two cultural levels. Level I (layers 2 - 5), comprised those layers characterised by tools of a Hoabinhian type. Floral and faunal remains indicate an economy based on broad-spectrum hunting and gathering with possible early domestication of legumes, bottle gourd, cucumber and Chinease water chestnut. This assemblage continues throughout level II (layer 1), but with the addition of new elements: flaked and ploished quadrangular adzes, small ground and polished slate knives, and cordmarked and burnished ceramics. Gorman regards the new elements as having been introduced, and points to similarities between them and artifacts from early agricultural sites on the plains (Gorman, 1971). The possibility of domestication within Hoabinhian contexts, and a radio-carbon date of 11,690 ± 560 B.P. placing initial Hoabinhian occupation of the site before the end of the Pleistocene, have called into question the wisdom of describing the Hoabinhian as 'Mesolithic' in the sense that the term was devised for European material.



SOUTH-EAST ASIA ~ MAJOR SITES FIG. 1

THE KHORAT PLATEAU.

The Khorat Plateau covers most of the eastern extension of Thailand, comprising the area enclosed by the Mekong River on the north and east, the Phetchabun and Dong Phrayayan mountains to the west, and the Dang Raek and Sankamphoeng mountains to the south.

Geologically, the plateau consists of a number of Triassic and Jurassic sandstone and conglomerate deposits making up the Khorat series overlying Permian limestone of the Kanchanaburi series (United Nations, 1968: 16). The Khorat series are typically divided into three formations, each containing a number of beds. The Lower Korat or Phu Kradung formation dating from the Triassic contains in order of deposition the Huai Hin Lat, Nam Phong and Phu Kradung deposits. The Middle Khorat, or Phra Wihan formation, has the Jurassic deposits of Phra Wihan, Sau Khua and Phu Phan, while the Upper Khorat Formation consists of the Ban Na Yo or Khok Kruat deposit, and the Salt Formation of the Cretaceous. The Khorat series are overlain by Quarternary alluvium, particularly in the centre of the plateau and along rivers (Department of Mineral Resources 1969). During the late Tertiary, the plateau was formed into the structure which exists today; a shallow basin some 160,000 square kilometers in area, tilted to the southeast and varying in height from approximately 100 meters above sea level in the southeast to approximately 300 meters above sea level in the north and west. A low, gently rolling landscape with small

shallow lakes and occasional hills becoming more numerous around the edge is typical of much of the plateau (Pendleton, 1962: 43; United Nations, 1968: 1).

The soils of the plateau, mainly loams weathered from sandstone of the Khorat series, tend to be thin and infertile. Pendleton (1962: 71-75) defines three major soils in Khorat. Khorat Fine Sandy Loams are the most common and are found particularly on lower mountain slopes. Roi Et Fine Sandy Loams and Kula Ronghai Silt Loams occur over considerable areas.

The climate of Khorat follows the same general pattern as that described for Thailand as a whole. However, the plateau receives considerably less rainfall than the average, since it lies within the rainshadow area formed by the Phetchabun and Dang Raek ranges, which limit the amount of rain falling during the southwest monsoon (Brown, et al, 1951: 14). Average annual rainfall recorded at the Khon Kaen station from 1911 until 1965 was 1256.3 millimeters, while annual average temperature for the years 1948 to 1965 was 27°C. (United Nations, 1968: 10).

Primarily because of the poor soils and relatively low rainfall, the predominant vegetation throughout much of the plateau is a stunted dry monsoon forest of three intergrading types: dwarf dipterocarp forests, dry forests of mainly bamboo species, and a thorny cover found commonly near villages (Pendleton, 1962: 94-97).

The Khorat Plateau is an area of great archaeological potential. The presence in the area of a prehistoric population of considerable antiquity (Bayard, 1970: 131; 1971: 113), and its close proximity to the centres of the later Funan and Khmer Empires, have resulted in the existence of a large number of sites containing a wide variety of material of different ages.

An examination of aerial photographs taken by the Royal Air Force during and immediately after World War II revealed an intense concentration of defended sites in the area between the Chi and Mun rivers, and immediately south of the upper reaches of the Mun (Williams-Hunt, 1950). Some of the sites were relatively modern, while some displayed a Khmer format, but over two hundred of them were designated pre-Khmer. The majority of these were surrounded by multiple concentric earthworks of a regular circular pattern. Some few were situated on rock outcrops; on four others concentric earthworks were extensive enough to prompt their description as 'metropoli'. Another group of the pre-Khmer sites were surrounded by irregular-shaped earthworks in a variety of configurations (Williams-Hunt, 1950: 32). Although some research was done in this promising area prior to the war (Lajonquiere, 1910; Siedenfaden, 1922; Wales, 1936), little if any follow-up work has been attempted since the publication of the survey.

In the early 1960's many more sites were discovered when a proposal by the United Nations to develop

the lower Mekong River for hydro-electric power initiated a number of site-surveys and salvage operations in the area. Perhaps the most far-reaching of these has been the five-year programme carried out by the University of Hawaii and the Fine Arts Department of Thailand. Site surveys carried out in the first season (1963-1964) investigated three areas to be inundated by dams: the upper reaches of the Lam Phra Phloeng River in the southwest of the plateau, and those of the Lam Pao and Nam Phong Rivers in northern Khorat (Solheim and Gorman 1966). In all, twenty-one sites were discovered, including shelters (Lam Phra Phloeng 1 and 2, Nam Phong 4 and 9), open habitation sites (Lam Pao 2 and 6, Nam Phong 2 and 5), habitation sites on mounds (Lam Pao 3 and 10, Nam Phong 6, 7 and 8), late cremation burial sites (Lam Pao 1 and 9), and sites retaining structural evidence (Lam Pao 4, 5, 7, and 8, Nam Pong 1 and 3). Test pits were excavated on some of the sites, while from others surface collections only were made. A considerable amount of pottery was recovered. Some of the Nam Phong sites which are situated in the Phu Wiang area will be discussed more fully later in this chapter.

The survey also conducted excavations at the site of Phimai, Nakhon Ratchasima province, and Ban Sao Lao, Kalasin province, (Solheim, Parker and Bayard, 1966). The site of Phimai deserves special mention because of a new type of pottery found there (Solheim, 1965). The site was laid down to the north-east of the town, immediately

inside the walls on a bulldozer cutting which had exposed alternating cultural and sterile layers. At the bottom of the site, which was radio-carbon dated prior to 40 A.D., a single cord-marked sherd gave way to a distinctive black ware which continued through the history of the site alongside a buff-coloured ware out of which it had arisen (Parker, 1972 personal communication). The black ware is coarse-textured and predominantly fibre-tempered, with a smooth dull surface which is commonly decorated, especially on the inside, with a spiral pattern formed by spatula burnish. The most common vessel form is a shallow bowl with a flat or concave bottom or a small ring stand. Round-bottomed pots also occur (Solheim, 1965b); The bowls in particular are similar to those from the same period at Ban Kao (Parker, 1972 personal communication). There is a tendency for bowls to become more frequent and pots less so through time. The black ware was not manufactured after 1180 A.D., the approximate date of the founding of the Khmer temple inside the town, under parts of which some of it was found stratfied.

In 1969, a further programme was initiated to cover other areas to be flooded. The research team consisted of staff members and students from the University of Otago and the University of Hawaii in liason with the Thai Fine Arts Department. Two areas were surveyed - one in Roi Et province, the other in Amphoe Phu Wiang, Khon Kaen province. Sites in the latter area will be

discussed later in this chapter.

The Roi Et survey was conducted on and around a large salt pan to the north of Ben Ta Nen village where today salt is produced and traded to surrounding villages. Eight sites, all mounds with a large variety of pottery eroding out of them, were discovered within a few kilometers of the salt pan and near the banks of the nearby Siao Yai river Higham and Parker, 1971: 4). Test excavations were carried out on three of these sites, and tentative sequences postulated. Three test squares, each two square meters in area, were excavated on Bo Phan Khan, and evidence for prehistoric salt-working was discovered in the form of an extensive terrace constructed some time after initial occupation of the site; on this terrace were a large number of inter-cutting pits similar in form to those used for salt-working in the area today. Stratigraphy indicated a gradual intensification then cessation of salt-working, followed by continual occupation, including a period where local sandstone was quarried until fairly recent times (Higham and Parker, 1971: 14). A radio-carbon date of 1660 $\pm$ 81 B.P. was obtained from the bottom

The site of Ban Ta Nen is on one of a group of mounds on which the modern village of the same name is situated. Excavation of a single two-meter square test pit containing eighteen layers revealed a sequence for this area of the site showing initial prolonged use for habitation, subsequent use for iron-smelting, and finally use as a habitation area once again. The three radio-

carbon dates from this site were from Layer 9 (1895 ± 83 B.P.), Layer 10 (1300 ± 238 B.P.), and Layer 13 (1540 ± 248 B.P.). The nearby excavation at Don Taphan, consisting of one test pit two square meters in area, contained forty-six layers in all. The thin occupational layers separated by layers of sterile sand have been interpreted as representing relatively continuous occupation interrupted by intermittent flooding (Higham and Parker, 1971: 24). Layer 5, the second occupation layer below the surface yielded a radio-carbon date of 1120 ± 80 B.P.; Layer 7, the third occupation layer, a date of 1750 ± 82 B.P.; Layer 35, the seventeenth occupation layer, a date of 1930 ± 83 B.P., while from the bottom of a pit below the twenty-first occupation layer came a date of 1975 ± 131 B.P.

In 1972, the Fine Arts Department of Thailand conducted relatively extensive excavations at the site of Ban Chiang east of Udon Thani in the north of the Khorat Plateau. Three levels were present at the site. The bottom level, designated Late Neolithic, contained polished stone tools and cord-marked or carved-paddle impressed earthenware. On top of this was a level characterised by the appearance of bronze tools and pottery painted with intricate designs in monochrome. Painting of pottery is present early in the level, with paint on rims only, extending to the whole pot as the level progresses in time. Utilisation of rice is attested by the presence of rice grains in a pot near the

top of the level. Numerous deer remains indicate the importance of this animal in the economy. A number of fired clay mushroom-shaped anvils used in pottery manufacture were present. Painted pottery, clay anvils, and deer remains are also present in the top level, where iron tools are in use (Pote, 1972, personal communication).

THE PHU WIANG AREA

Phu Wiang mountain is situated at the western edge of the Khorat Plateau about 60 km west of Khon Kaen city in Phu Wiang district, Khon Kaen province. It is a monadnock, a remnant of the former land surface, comprised of two formations of the Khorat series - hard pinkish Phu Phan sandstone overlying more friable grey-green Phra Wihan sandstone which in turn lies on the soft red Phu Kradung sandstone forming the bedrock of the surrounding plain. Weathering of the interior of the monadnock has converted its shape into that of a 'ring-mountain' with a flat interior plain, a hundred square kilometers in area and elevated about twenty meters above the surrounding plateau. The interior plain is enclosed by a ring wall which rises to approximately five hundred meters above the surrounding plain and which is broken in only one place to the east, allowing easy access to the area outside the mountain. It is drained by a single perennial stream, the Huai Bong, and its tributaries through the eastern gap, (see Figure 2.).

In general, the climate of the area is much the same as that of Khorat as a whole, although the interior plain of Phu Wiang mountain is itself a rain-shadow area with average annual precipitation and average annual temperatures somewhat lower than those of the surrounding plain, (Bayard, 1971: 41; Higham and Parker, 1971: 25).

Soils are mainly the infertile sandy loams common to the rest of Khorat, which in the interior plain are mixed with varying amounts of recent alluvium, (Higham and Parker, 1971: 26).

Because of varying altitude and consequent difference in ecological conditions, natural vegetation varies. The flat tree-dotted ricelands of the interior and surrounding plains give way to dense scrub forest of Pendleton's dwarf dry monsoon type on the adjacent hills, becoming more dense still at the foot of the mountain. Forest comprised of larger, more sparsely spaced trees dominates the mountainsides until the triple-canopied moist monsoon forest on top of the mountain is reached.

Eleven modern villages are situated on the central plain of the mountain, as are nine smaller hamlets (Higham and Parker, 1971: 26). It has been estimated that the present population inside the mountain is about 10,000 (Bayard, 1972, personal communication), giving a population density of approximately one hundred per square kilometer; this is higher than that for Khon Kaen province as a whole which had a population density of 72.3

per square kilometer at the time of the 1965 census, although this figure is probably higher today. Ethnolinguistically, the population are Thai-Lao, the predominant group for much of the Khorat Plateau. The people work individual farms, growing a variety of crops and raising domestic animals for subsistance and traction purposes in addition to the staple wet rice, although some cash crops are grown. Farms are usually quite small, averaging four to six hectares in size, and for the most part are owner-operated. By far the most important means of livelihood is cultivation of glutinous rice on padi fields in the interior plain. Since rice requires an average of seventy inches of rainfall during the growing season to mature satisfactorily, and since the area does not receive nearly so much, irrigation is necessary. Although the interior plain is a rainshadow area, the number of small streams draining it, along with seasonal flooding, make irrigation possible. However, irrigation is not practised outside the mountain. Little rice is produced for export. Villagers supplement their livelihood by thorough exploitation of the full range of their environment. Cash and food crops such as jute, cotton, mulberry, coconuts, bananas, red pepper and mangoes are grown on isolated mounds in padi fields, and in upland regions (jute, kenaf, cotton, tobacco, squash, beans and onions), where swidden cultivation is carried out extensively. Forests provide an abundance of game, notably wild pigs, deer and monkeys, and are a source of

timber which is used for building and for fuel. Fish are taken from rivers and ponds. Domestic animals are raised in the villages, water buffalo for traction in the padis, zebu for pulling carts, pigs, chickens and ducks for consumption. Most households have their own garden patch near the village, where a variety of vegetables such as peas, beans, onions, garlic, tomatoes, pumpkins, betel, pepper, lettuce and cabbage are grown; many wild vegetables are also gathered (Higham and Parker, 1971: 26; Bayard, 1971: 42-50). Bayard (1972: 42-50) has defined seven microenvironmental zones recognised as such by some of the population and differentially utilised by most.

Villages are centres for a number of cottage industries. The most common of these is the manufacture and weaving of cotton and silk fibre; from silkworms which feed on the mulberry treas grown near the villages. Little pottery is made today inside the mountain (Bayard, 1972; Parker, 1972; Pote, 1972, pers. comm.). However, locally-made pots are in plentiful supply in markets outside the mountain. All of these pots are manufactured in villages which specialise in pottery making. There are a number of such villages in the general area, one quite close to the mountain - two of these have recently been studied (Solheim, 1964b; Calder, 1972). Both accounts of the manufacturing process agree in all essential details. All pottery in the area is hand-made. The wheel is little-used in

Northeast Thailand. Only one village in the Khorat Plateau is known to make any great use of it - Ban Dan Kuan in southeast Khorat (Pote, 1972, pers. comm.). However, the wheel is employed commonly in other districts, notably in North Thailand, where a slow foot or hand-turned wheel is used.

The similarity of much of the prehistoric pottery to modern pottery in the area in both physical characteristics and method of manufacture warrants a summary of modern pottery-making methods.

Clay for pottery-making is gathered from local ponds or stream beds. Only one tempering material is used: pre-fired clay-and-rice-chaff balls which are pounded, sieved and added to the raw clay. Pottery-making is almost entirely carried out by women except for preparation of the clay and firing, with which men occasionally help. Pots are formed from a hollow clay cylinder, open at both ends. After initial enlargement of the cylinder, the rim is formed by finger pressure as the potter moves round the pot, which is usually elevated off the ground on a wooden pedestal. The body is then beaten into shape, and the end closed over by beating the outside of the pot with a wooden paddle, while at first the potter's hand, then later a mushroom-shaped clay anvil supports the pot on the inside. When the pot is partially dry, the outside surface is smoothed, and decoration applied, commonly in the form of a band of carved-padle decoration around the shoulder. Open-

firing is employed. After drying, the pots are placed upside down on a structure of brushwood, which is ignited and stoked for several hours, then allowed to cool. Because of the difficulty in maintaining even temperatures during firing, the quality of the pottery varies considerably, even within one pot. The nature of the firing also affects the colour of the vessels. While most are buff in colour, oxidation and reduction during firing frequently produce orange and black patches respectively, and fireclouds are common (Solheim, 1964b; Calder, 1972).

The sites which provided the pottery for this research are all situated on the interior plain of Phu Wiang mountain (see Figure 2).

Non Nong Chik is a low mound in the extreme northeast of the plain. Two test squares were excavated on top of the mound, but material from only one of them, square 1A was used, because of extensive disturbance in the other square, square 1B. Test square 1A, to the west of the mound, was two square meters in area and had a cultural deposit of eight layers, achieving a depth of 148 centimeters before natural soil was reached. In spite of the disturbed nature of square 1B, the stratigraphy was sufficiently clear to allow the assumption to be made of stratigraphic equivalence between the two squares. The site seems to have been used almost exclusively as a cemetery. Apart from two postholes and several shallow pits in square 1B, cut from the bottom of layer 4, no evidence of habitation has

been found. However, since no burials were cut from layer 4, it is possible that for this period of its history the site was occupied.

Since pottery from square 1B was not used, the stratigraphy of square 1A only will be described. Layer 1 was a fine-grained, sandy grey-brown modern agricultural soil, alluvial in origin and extending to a depth of fifteen centimeters. A large number of predominantly cord-marked sherds were found spread thickly over the site. Sherds within the layer were sparse, and included plain earthenware and some late incised stoneware. Many fragments of orange-red Phu Kradung sandstone were found in this layer. Layer 2 (15 - 32 centimeters) was similar in appearance to layer 1, although soil was a lighter grey in colour, grading to red in the northeast corner of the square where a large concentration of sandstone was present. A larger concentration of sherds were found in this layer than in the preceeding one. Layers 1 and 2 were heavily leached and greatly disturbed due to prolonged agricultural activity on the mound prior to excavation. The major crop cultivated was jute, which involved regular ploughing. Because of this, sherds in both layers were much broken and eroded. Layer 3 (32 - 50 cm.) consisted of a yellow-brown soil containing some clay. It was rich in potsherds, mainly sand-tempered and cordmarked, of greater size and number than those in the previous layers. Some of them closely resemble those from the Iron Period

at Non Nok Tha (Parker, 1970, field notes). Several fragments of bronze and a socketed iron axe occurred in this layer as well as a spindle whorl and quantities of animal bone and sandstone. The soil of layer 4, while similar to that of layer 3, is darker yellow in colour, and rather more loamy. The sherds in the layer are more sparse than those in layer 3, and are all cordmarked except for one painted sherd (Stapleton, 1970, field notes). Two fragments of bronze, some iron slag, one spindle whorl, several clay pellets for a pellet-bow, and a number of unfired tempered clay lumps were also found. Layer 5 (65 - 76 cm.), was composed of a brighter yellow, more compact, soft soil, containing lumps of dark grey and yellow clay. There was a further decrease in the number of sherds in this layer. More clay pellets and some charcoal were found, and at a depth of 75 centimeters a fragment of a bronze bracelet. The one burial found in square 1A was cut from the top of layer 5 down into layer 7. It was covered by a mound which extended up into the top of layer 4. The skeleton was supine, with the hands by the sides; pots and two pig mandibles were placed around the legs. Layer 6, (76-100 cm.), was more loamy and easier to work than layer 5, and contained lenses of yellow, grey and brown soils with few sherds. Red and black cord-marked wares were the most common. Also present were a large number of gastropod shells, a stone bracelet, a fragment of bronze, and some clay pellets. Layer 7, a compact gritty grey soil mixed with yellow clay, contained a few sherds, more gastropod shells, and

some red ochre. Layer 8, more yellow in colour with flecks of yellow and orange-coloured-clay and hard clay-like concretions through it, was sterile except for a few intrusive sherds, (Stapleton, 1970, field notes; Higham and Parker, 1971: 31-36). Six radio-carbon dates came from Non Non Chik, the only one of the four sites from which dates were obtained. Five dates from square 1B were: 2,900 ± 120 B.P. from a post-layer 3 burial; 2160 ± 270 B.P. from layer 3 or 4; 2120 ± 75 BP. from layer 5; 2340 ± 76 B.P. for layers 6 and 7 combined, and a date from layer 7 of 2830 ± 105 B.P. From square 1A layer 7, came a date of 3180 ± 95 B.P.

The site of Don Sawan is situated in the middle of the interior plain. One test square, 1½ square meters in area was excavated. It is a large mound on which is built the village of Ban Nong Khu. Layer 1 (0 - 18 cm.), was composed of a soft, yellow sandy agricultural soil containing only a few sherds, among them several pieces of thick laterite-tempered ware and one glazed sherd. In layer 2 (18 - 28 cm.), a dark grey sandy soil with some clay, were more of the laterite-tempered sherds, some iron-slag and two clay pipes. Layer 3 (28 - 40 cm), was a soft grey sandy soil with a few sherds and some iron slag while layer 4 (40 - 50 cm.), was dark brown and clayey and contained a number of red-orange earthenware sherds. Layer 5 (50 - 60 cm.), was similar in composition to layer 4, except that it contained more clay. Many sherds were found in this layer, among them

a number of red-painted rim sherds. Other finds were some wild pig bones, a small fragment of bronze, and iron slag. Layer 6 (60 - 75 cm.) was a soft grey-brown clay containing still more clay. Few sherds occurred, most of those present being cordmarked. Also present in the layer were some animal bones, possibly cattle, several pieces of iron, and one spindle whorl. Layer 7, (75 - 85 cm.) was a soft grey soil with moderate amounts of clay and sand. Ceramic material in this layer was dominated by soft red earthenware although considerable amounts of a black cord-marked ware were also present. Among the large quantities of animal bone present, those of cattle and pig predominated. One piece of bone had been worked. Some charcoal and several pieces of sandstone were found. Layer 8 (85 - 100 cm.), a soft grey clay layer, contained rather a lot of pottery, particularly sherds of soft grey and brown cordmarked earthenware. A large amount of burnt bone was present. Burial 1 had been cut from this layer. The skeleton was slightly contracted and the grave was without grave goods. Layer 9 (100 - 112 cm.), a grey sandy soil, had in it little cultural material apart from a few sherds and some animal bone. Layer 10 was a soft grey clayey soil with only a few sherds, most of them thin black ware, and some charcoal. Layer 11 (125 - 145 cm.) was a dark grey clay, similar in cultural content to layer 10, with the addition of some animal bone. Little cultural material except for a small number of sherds was found in

layer 12 (145 - 163 cm) which was a red-brown soil with some clay. Layer 13 was a hard grey soil containing approximately equal amounts of clay and sand. In it were sherds of both the thin black and soft grey-orange wares, as well as some charcoal. Natural soil was reached at a depth of 180 centimeters, and was excavated to a depth of 210 centimeters. A soft red-orange soil with equal amounts of clay and sand, it was found to be sterile.

The remaining two sites are part of a complex of sites in the vicinity of Ban Pho village in the southwest of the interior plain. They are Don Wat Kao, designated Ban Pho number 1, and Don Kok, (Ban Pho number 3). The Ban Pho sites include: mounds containing or thought to contain cultural material (Ban Pho 2, 4, 5, 9, 10); burial sites (Ban Pho 6 and 11); 1 rock shelter containing paintings (Ban Pho 12); what appears to be a transitory campsite (Ban Pho 7); and material from the vicinity of the wat in the village of Ban Nong Bua, including an inhumation burial with a stone adze, and sandstone blocks with inscriptions in what was originally believed to be Khmer script, but what is probably old Lao (Higham & Parker, 1971: 54 - 57).

Don Wat Kao is a low circular mound on the outskirts of the village on its southern side. A test square 1.5 square meters in area was excavated in a garden area on the edge of the mound. Layer 1 (10 - 20 cm.), was the grey-brown sandy topsoil. It had been continuously

cultivated for a considerable period of time, and was well-leached so that the sherds in it tended to be worn, but where distinguishable these were predominantly cordmarked. As well as quantities of charcoal, red Phu Kradung sandstone and iron slag, the layer contained glazed ceramic ware, and the sixteenth century clay pipes which first drew attention to the site. Layer 2 (20 - 45 cm.), was a light brown soil mottled with yellow and grey clay. In it were s small number of sherds, several sandstone blocks, charcoal and iron slag. Layer 3 (45 - 65 cm), was similar in composition to Layer 2, although a darker red-yellow in colour, and easier to work. Little cultural material was present, apart from several pieces of soft red-brown sandstone, one piece of animal bone and some iron slag. As with layer 3, little cultural material was found in layer 4, (65 - 85 cm.), a reddish soil with bright red and yellow clay patches. Some few sherds, several pieces of sandstone, and burnt clay were found. At depths of between 70 and 78 centimeters, a layer of dark red soil was found to extend over the entire square. It is thought to have been caused by leaching (Higham and Parker, 1971: 39). In layer 5 (85 - 110 cm.), a lighter red moist sandy soil streaked with yellow, were rather more potsherds than in the preceeding layers, as well as quantities of iron slag. Layer 6 (110 - 130 cm.), was a soil similar to that of layer 5, but once again little cultural material occurred. Large quantities of

charcoal were present, but few sherds. Layer 7 (130 - 150 cm.), also similar in composition to the two preceding layers, was sterile except for two sherds and some charcoal. Natural soil lay below 150 centimeters.

Don Kok (Ban Pho 3) is a large scrub-covered mound rising 1 - 1½ meters above the surrounding fields immediately to the southwest of Ban Pho village. Only three major layers were distinguished (Parker, 1972), although these have elsewhere been subdivided according to minor soil changes (Higham and Parker, 1971: 41). Layer 1 (0 - 25 cm.) was a dark grey, sandy, well-ploughed agricultural soil, which for the most part was sterile. Only a few scattered small eroded sherds occurred. Layer 2 (25 - 80 cm.) was a somewhat hard brown-grey soil containing rather more sherds than layer 1. Particularly common were small sherds of a soft red ware, and a number of thick coarse sherds tempered with small laterite pebbles. Layer 3 (80 - 100 cm.) was sterile except for intrusive material; three concentrations of large sherds and bone fragments filling pits cut from a higher level. This was possibly layer 2, although it proved difficult to determine the exact position from which the pits had been cut or to define their edges accurately (Parker, 1970). These pits may represent the remains of inhumation burials, although human bone was found in only one of them. Two of the pits were stratified some 15 centimeters above the others.

Four of the Nam Phong sites (Solheim and Gorman, 1966), are situated in the immediate area of Phu Wiang mountain (Figure 2.). Nam Phong 6 (Don Kok Pho) is a large mound (ca. 200,000 square meters in area) approximately 1 kilometer west of the village of Ban Na Kham, just to the northeast of the mountain. Sherds of earthenware, Sukhothai, Ming and Ayuthia wares, and blue-on-white porcelain were collected from the surface of the mound. Earthenware pastes were of two major kinds: predominantly sand with a small amount of clay, and predominantly clay with a small amount of sand. Sherd surfaces were plain or impressed with a bound or carved paddle. Other significant finds included clay pipes, slag, and a small amount of bronze (Solheim and Gorman, 1966: 176).

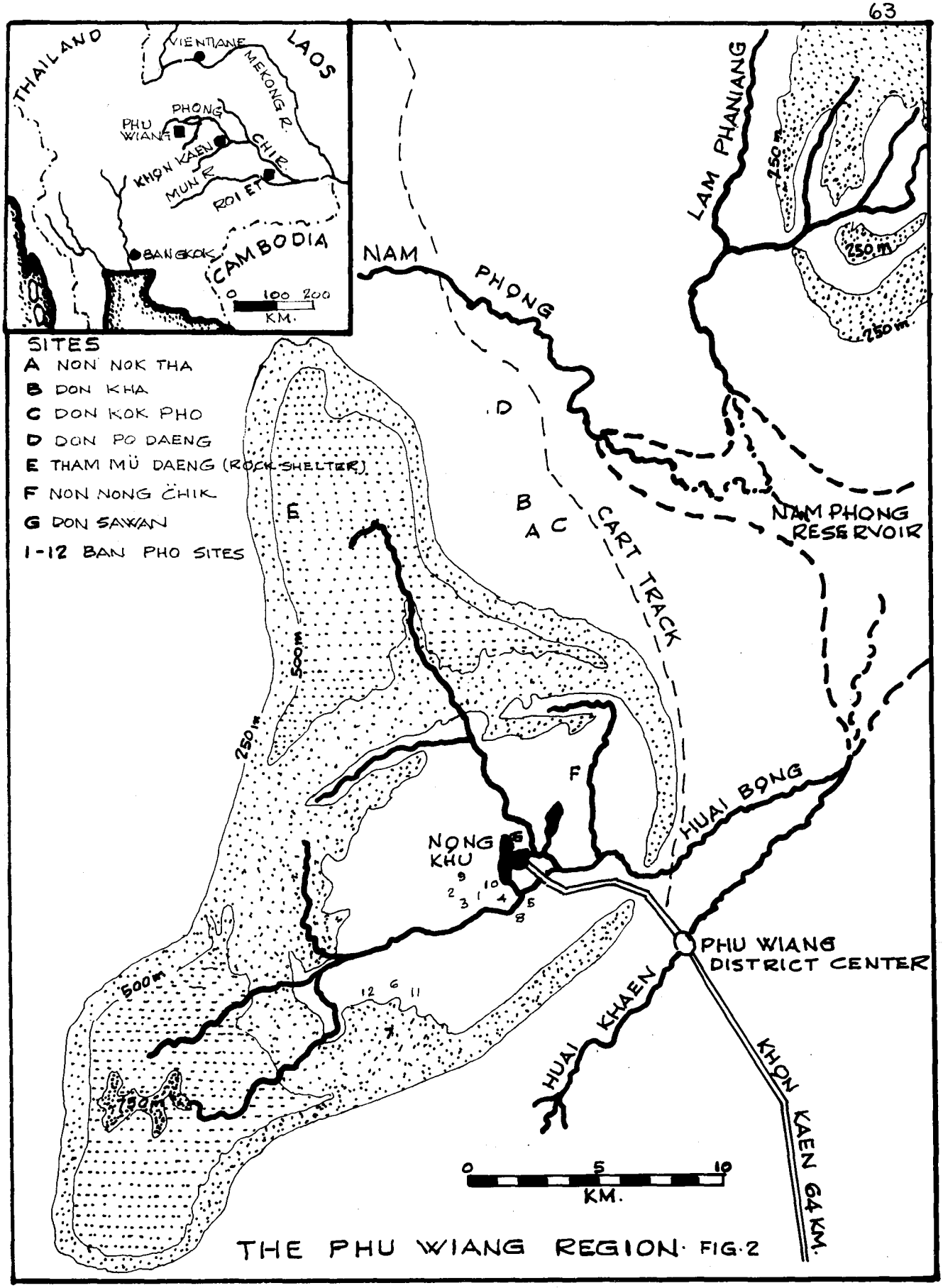
Nam Phong 8 (Don Po Daeng) is a site some 2,700 square meters in area situated on a large laterite outcrop about 4.5 kilometers north-northwest of N.P. 6. A dense accumulation of sherds was present. All of those collected were unglazed earthenware except for 1 porcelain sherd. Pastes and surface treatment were the same as those at N.P. 6. At this site, however, it appeard that the cordmarked sherds were associated with the predominantly sand-tempered paste, while the plain and carved-paddle-impressed sherds were associated with the predominantly clay-tempered paste. Clay pipes, metal slag, a tanged iron blade, and animal bones were also present (Solheim and Gorman, 1966: 177-178).

Nam Phong 9 (Tham Mu Daeng) is a large sandstone shelter on the gentle inner slope of the western rim of Phu Wiang mountain. Above an opening in the rear of the shelter leading to a small chamber were outlines in red of nine human hands of various sizes (Solheim and Gorman, 1966: 178). Cultural affiliations and the date of the site are unknown.

The only Nam Phong site to have been excavated to any great extent has been Nam Phong 7 (Non Nok Tha), a small mound (15,000 square meters) located approximately ½ kilometer south of the village of Ban Na Di. During the first season of the University of Hawaii-Thai Fine Arts Department survey, some unglazed earthenware sherds of the same pastes present at N.P. 6 and 8 were collected from the surfact of the mound (Solheim and Gorman, 1966: 176). The site was extensively tested the following year, and from December 1 1965 until April 1966 a large-scale area excavation totalling some 150 square meters was carried out. In 1968, a second area of 190 square meters was excavated. The evidence for the two seasons, although generally in close agreement, cannot be conclusively combined within a single stratigraphic framework. Some layers present in each are absent in the other, and the owners of the site prevented further excavation to enable a direct stratigraphic link to be established. A summary of the tentative combined sequence will suffice to demonstrate the nature of the site. Eleven cultural layers were present and were

organised into eleven slightly different levels based primarily on changes in burial style and pottery (Bayard, 1970: 121-129; 1971: 104-108). From this evidence two distinct periods of occupation of the site were postulated, separated by a gap in the sequence during which new elements were introduced (Bayard, 1970: 134-137). The first half of the sequence can be subdivided into an early period of three levels and a middle period of eight levels. During the Early Period, tools were predominantly of polished stone, with some of bone and antler. A small amount of copper is present in E.P. 3. The large number of inhumation burials discovered contain multiple offerings of stone and bone tools, animal bones, and many pots. Most of the pottery is cordmarked. The presence of rice-chaff-tempered pottery points to the utilisation of rice. In conjunction with structural remains indicating a semi-sedentary settlement pattern during the Middle Period, this could possible represent the practice of swidden cultivation of rice. The Middle Period itself is distinguished from the Early Period by the appearance of new types of burial pottery: footed globular bowls and goblets, and pedastalled shallow bowls. However, the round-bottomed cordmarked pots of the previous levels are still present. Inhumation burials are concentrated, during M.P. 1 - 4, with rich grave goods; grave goods are not so elaborate during M.P. 5 - 8. The elaborate M.P. 1 burials are of four types, localised in separate parts of the site. Evidence for intensive

bronze-working is present in the relatively large number of bronze tools, sandstone moulds, and crucibles. By M.P. 5, the east and central parts of the site were in use for habitation; remains of several partly overlapping buildings were found in these areas. During M.P. 6, however, the site was again entirely in use as a cemetery. Following the gap in the sequence, after two more levels in the 1966 sequence (M.P. 7 & 8) but not in the 1968 sequence, the Late Period shows the marked changes that had taken place. Iron tools are present, and the practice of cremation burial suggests the introduction of a new ideology. Structural remains show smaller houses than before, nearer in proportion to the houses lived in by the sedentary modern wet-rice farmers in the area. In addition to the animals of the early period, the water buffalo and domestic fowl also occur. Bayard suggests an economy based on wet-rice agriculture rather than swidden. Pottery is substantially a continuation of the earlier tradition, except for an increase in the number of imported sherds. Bayard considers that the sequence can be seen in terms of three periods of relative stability (E.P. 1 - 3, M.P. 4 - 8 and L.P. 1 - 5), interspersed by three periods during which readjustment to novel conditions took place (M.P. 1 - 2, gap in sequence, and L.P. 6, i.e. from 1935 - present), (Bayard, 1971: 308-313).



THE PHU WIANG REGION. FIG. 2

CHAPTER 3.

RESEARCH METHODS

In the field, all potsherds recovered from each layer of an excavation were placed into numbered bags on which were marked the name of the site and the test square from which the sherds had come. The provenance of the contents of the bags was recorded in a field notebook kept for each test square. The bags were weighed, and a bag list compiled for each site showing the contents and weight of each bag.

On their arrival in New Zealand, the bags were marked with the provenance of their contents, and checked off against the bag lists to allow calculation of the number of bags present, since some had unfortunately been lost in Thailand. The final sample included fifty-one bags from Non Nong Chik, eighteen from Don Sawan, seven from Don Wat Kao, and eleven from Don Kok. To remove adhering soil, the pottery was cleaned in bag lots using a commercial steam-cleaning machine, then returned to its original bag to await analysis.

Reference to field notes and bag lists indicated those bags containing wholly or partially restorable pots. These were isolated, and reconstruction begun.

On closer examination of the sherds to be restored, it was discovered that a large proportion had adhering to them hard lime concretions which had not been removed during steam-cleaning. Since successful reconstruction depended on the elimination of all extraneous matter on sherd surfaces, particularly on edges to be joined, further cleaning was necessary. Prolonged abrasion was considered inadvisable, since the risk of damage to the surface of the sherds was too great. Immersion in a dilute solution of hydrochloric acid (10% strength by volume), followed by gentle scrubbing with a soft brush in warm water, removed the concretions without damage to the sherds. After cleaning, each sherd was marked with its site name, bag number and provenance.

Some difficulty was encountered in the selection of a suitable adhesive, since the requirements were stringent. It was necessary that the adhesive be sufficiently strong to both join the weighty sherds and to remain on their often friable surfaces. It had to be able to dry quickly enough to avoid undue delay in reconstruction, yet not so quickly as to prevent manipulation of the sherds if necessary after they had been joined. A soluble adhesive was desirable, since it was intended that the restored vessels be later broken down to allow

easy transportation back to Thailand. After extensive testing in the laboratory, a strong water-soluble polyvinyl acetate glue was found to be the most satisfactory available.

In all, ten pots were restored, six completely and four partially. A complete reconstruction was considered to be one in which the profile of the vessel could be determined, i.e., at least one side and the bottom. Four of the vessels were quite small, and six large. Reconstruction of the small pots presented few difficulties because of the relatively few sherds involved, and because of the ease with which the vessels could be supported while drying. Each was completed in several days. That of the larger pots, however, proved to be more time-consuming as work had to progress primarily on a trial-and-error basis due to initial lack of knowledge of the size and shape of the vessels, and to the difficulty in matching the numerous similar cord-marked sherds comprising their bodies. To begin with, it was intended that the rims should be reconstructed first and the remainder of the vessel built up from there. However, additional problems had to be overcome in the discovery of a suitable method of keeping joined sherds in position until the adhesive had dried. A sand tray was found to be valuable in supporting small sherd constructions, with the addition of polystyrene blocks piled on top of one another for larger ones. Eventually, it was decided to prefabricate several

sections of the pot and join them together after which small cracks were filled in with more adhesive, using a hypodermic syringe. Each of the large pots took several weeks to complete. When reconstruction was under way, work on the non-reconstructible pottery began.

Each complete pot and each bag of pottery was assigned a catalogue number. A catalogue book was kept for each of the bag or bags comprising one number. Information on the pottery was recorded in code on a specially designed form consisting of eighty columns, representing the columns on a computer data card on to which the contents of the form were later to be punched. The cards' eighty columns, arranged in six rows, are divided into thirty-eight pottery variables.

In the first two rows are recorded information for all pottery. Row one provides details of the site (columns 1 - 2), catalogue number (columns 3 - 7), square (columns 8 - 11), layer (columns 12 - 13) and sublayer (column 14), and row two of burial number if applicable (columns 15 - 17), accuracy of provenance (column 18), and temper (material code columns 9 - 25).

Row three is given over to rim description - rim form (columns 26 - 27), general surface treatment of outer rim (column 28), incised or impressed designs on outer rim if present (column 29), initial surface treatment of the inside of the rim (column 30), incised or impressed designs on the inside of the rim (column 31), external rim diameter (columns 32 - 33), external

diameter at the junction of the rim and the body (column 34 - 35) and the height of the rim (columns 36 - 38).

Row four describes the treatment of the shoulder, the shoulder being differentiated only when a difference in surface treatment allows it to be distinguished from the body of the pot. Space is provided for description of initial surface treatment of the shoulder (columns 39 - 40), incised or impressed designs (column 41), designs in applique (columns 42 - 43), decorations on applique designs (column 44), and width of shoulder (columns 45 - 46).

The body description contained in row five includes body form for complete pots (columns 47 - 48), surface treatment of the body (columns 49 - 50), maximum width of a complete vessel (columns 51 - 52), total height of a complete vessel (columns 53 - 54) and average thickness of the wall of the body of the pot (columns 55 - 56). The foot can be described in row six in terms of foot form (columns 57 - 58), initial surface treatment of the inside of the foot (column 59), incised or impressed designs on the outside of the foot if present (column 60), initial surface treatment of the inside of the foot (column 61), surface treatment of the base of the pot inside the foot (column 62), applique designs on the foot (columns 63 - 64), external diameter of the foot or the bottom of the pot (columns 65 - 66), minimum diameter at the junction of the foot and the

body (columns 67 - 68), and the height of the foot (columns 69 - 70).

In the seventh row are recorded the presence of striations, perforations or cutouts on the rim or the foot (columns 71 - 72), the interior finish of the sherds if anything other than plain (column 73), the total number of sherds dealt with on the card (columns 73 or 74 - 76) and their total weight (columns 77 - 80). Thus anything from a single sherd to a complete pot can be recorded on one card.

The code used was one adapted by Bayard (1971) from one devised by Newman (n.d.) for Hawaiian archaeological material, and used by Bayard in the analysis of ceramic data from the site of Non Nok Tha. The complete code allows for the description of non-pottery data as well. Numbers were assigned arbitrarily to a range of specific choices within each pottery variable except of course for quantitative variables. These choices were compiled from commonly occurring elements in pottery from Non Nok Tha and other sites in the immediate area. As work progressed, additions had to be made as new elements not present in the Non Nok Tha pottery appeared.

The material code is arranged hierarchically. Thus, for example, 7 represented inorganic remains, 71 ceramics, 711 earthenware ceramics, 7112 sand-tempered earthenware ceramics and 71121 hard sand-tempered earthenware ceramics. Similarly 712 represents high-fired earthenware verging on stoneware, 713 stoneware

proper, 714 semi-vitreous proto-porcelain, and 715 true porcelain, with temper categories arranged within the first two in the same fashion as for earthenware. Those for proto-porcelain, and porcelain proper are based on glases. The code for no other variable was arranged in this way. That for rim form, for example, was based on arbitrary categories of form ranging from 01 through to 65, while in the code for surface treatment of the outer rim, 01 represents a plain surface, 02 a red-slipped surface, 03 a polished surface, and so on.

Owing to the size of the code (60 odd pages), it cannot be reproduced here. A brief summary of it will follow, while specific variables will be discussed in more detail where necessary in the following chapter.

Basic temper categories are: no temper (7111), sand temper (7112), rice chaff temper (7113), laterite temper (7114), and prepared temper - either ground potsherds or ground fired clay and chaff balls - (7115). Other temper categories are combinations or modifications of these major ones. 71123 is a predominantly sand temper, with some chaff included, while 711231 represents a temper of sand, chaff, iron slag and clay. In all, there are thirty-nine temper categories considered in this study.

Major elements of surface treatment for rim, shoulder, body and foot are: plain or polished surface; red, white, buff, grey, black, or other dark slip; painted decorations of various colours and complexity on

a plain or slipped surface; an organic or wax coating; simple or complex incised decorations; designs impressed with a carved or a bound paddle (cordmarking) or a stamp; and decorations in applique.

Rim forms are illustrated in Appendix I; The smaller number of body forms and foot forms will be described in the text of the following chapter.

Each reconstructed pot was recorded on a separate coding form, giving details of rim form and decoration, shoulder decoration, and body form and finish; a foot was present on only one pot. Overall measurements were also recorded. In some cases, sherds belonging to one pot were found in several bags. When this occurred, a separate catalogue number was given to remaining sherds in each bag. The total number of sherds comprising the pot were counted, old breaks only being used to define a single sherd. The entire reconstructed pot was then weighed.

The non-reconstructable pottery was initially sorted by hand. Sherds in each bag were divided first of all into rim sherds, shoulder sherds, body sherds, foot sherds, and mixed sherds (those sherds incorporating in them two or more of the other four categories). Those sherds which could not be positively identified as belonging to rim, shoulder or foot were designated body sherds. Tempering material was determined by examining the edges of each sherd under a low-powered binocular microscope. In some cases, fresh breaks had to be made

where the edge was obscured by erosion or ingrained dirt. Where it was considered practicable, dilute hydrochloric acid was used to remove resistant dirt. Each group of sherds of similar temper was then examined to determine surface treatment. Finally rim and foot forms were assigned where applicable. Sherds with identical characteristics, or those which could definitely be said to have come from the same vessel, were coded together on one form. As with complete pots, only old breaks were considered in counting sherds. Where new breaks had occurred and could be found to fit together with another sherd, the two were counted as a single sherd. The average thickness of all body sherds coded on one card was calculated by measurement with vernier calipers. All sherds coded on one form were weighed to the nearest gram on a Mettler balance. The information on the coding forms was punched onto computer data cards. A "list 80" of all cards was obtained and checked against the data forms to ensure accurate punching.

A general computer programme was written by R. Molloy of the University of Otago Medical School to perform analysis on the data. Initially, the data were separated by computer into the five categories of rim, shoulder, body, foot and mixed sherds, and percentages by number and by weight were obtained for each category in terms of the total sherds in a particular layer. An adapted programme performed a similar operation on variables within each sherd category,

except for those quantitative variables in columns 32, 38, 45 - 46, 51 - 56, 63 - 70 and 74 - 80. For example, percentage by number and by weight were provided for sherds of each rim form making up total rim sherds in each layer.

Mixed sherds were kept apart and analysed separately except for temper analysis since their inclusion in the analysis of other qualitative variables would have resulted in a distortion of site and layer totals. Reconstructed pots were also included only in temper analysis since they were burial pottery rather than refuse sherds, and because it was intended that each should be described in detail.

Results were plotted on a graph to give an indication of changes in each attribute over time at a particular site.

A further programme was written to perform a chi-square test of association on one pair of variables - temper and body decoration. Due to the small number of positively identifiable rim sherds no test of association could be carried out using this variable. Other variables were omitted either because they showed almost no variation (for example rim decoration for both outer and inner rim was almost always plain), or because some sherd categories occurred so infrequently (as in the case of shoulder and foot sherds) that computer analysis was not practible.

A copy of the programme can be found in Appendix V.

CHAPTER 4.

RESULTS

Before presenting the results of the analyses, some comments on the nature of the data are in order. To begin with, the ceramic samples from each of the four sites are not random ones. The test pits were laid down on areas of the site that appeared promising as far as depth of stratigraphy and content were concerned. This had to be kept in mind at all stages of the analysis and those results that could have been attributed to sampling error taken into account. Secondly, the fact that the ceramics from each site were represented by material from only a single test square reduced the chances of the sample being a truly representative one. Finally, sample size was too small to allow the conclusion that a complete investigation of the sites as a whole had been made.

The effects of this were not noticeable to a great extent in the temper analysis, in which all sherds

were included, or in the analysis of surface treatment of the body, as the majority of the sherds fell into the body category. However, the other sherd categories - rim, shoulder and foot - contained relatively few sherds so that frequently large percentages represented by only several sherds occurred. This was especially true of the sites of Don Wat Kao and Don Kok, where results were sufficiently inconclusive to prompt consideration being given to withdrawing them from the study. Inadequate thought it may be, data from these two sites are included here, since in some instances they would seem to support the trends apparent at Non Nong Chik and Don Sawan. An added disadvantage was apparent in that the majority of the rim sherds from all sites were badly damaged by erosion or fragmentation, so that neither their form nor the mode of surface treatment could be determined.

Results of the analyses are presented in full in table form in Appendix II; a summary will be given in this chapter. In general, the results of the analysis of the mixed sherds supported those of the unmixed sherds, and percentages by weight and by number agreed quite closely. In the following discussion, no distinction will be made between mixed and unmixed sherds unless marked differences are present. In all, 5504 sherds were analysed from Non Nong Chik, 2502 from Don Sawan, 193 from Don Wat Kao, and 1616 from Don Kok.

NON NONG CHIK

Temper in sherds from Non Nong Chik, more than any of the other sites is characterised by a great variety of temper types within the four major categories - sand, chaff, laterite and prepared temper. Proliferation begins in Layer 7 with a total of 15 tempers compared with only the three present in the handful of sherds from layer 8, and continues until layer 3, with new additions in each layer. In layer 2, the number of temper types is reduced by almost one third, while in layer 1, only four types are present despite the moderately large numbers of sherds from both layers. It appears that throughout the middle of the sequence the potters who made the Non Nong Chik pottery made use of a wide range of tempers, but by the end had become conservative to the extent that only relatively few tempers were used. A case cannot be made for a similar conservatism at the lower end of the sequence, since layer 8 yielded only 8 sherds, so that it is possible that considerable variety was present from the beginning.

Sand temper is predominant throughout. Hard sand temper (medium amounts of large grains of sand, high-fired, but not friable) is markedly so from layer 7 through until layer 2. In layer 1, no hard sand temper is present, its place being taken by soft sand (friable sherds containing more sand of a smaller grain) which is present throughout the sequence in quite small quantities except in layer 5, where a sharp rise in it is paralleled

by an equally sharp drop in the occurrence of hard sand temper. In layer 8, the highest temper frequency is of sand and chaff. Sand is also present as a minor inclusion with other tempers in a number of cases, for example laterite and sand. If all sand categories are combined, a steady decrease of approximately 20% is apparent in sand temper from a peak in layer 6 to its disappearance in layer 2.

Prepared temper also decreases towards the upper end of the sequence, although its presence is never marked. Within this category, the most common type is prepared clay consisting of ground fired potsherds or other fired clay. Other prepared tempers such as ground fired clay and fibre balls (prepared temper proper), clay and chaff, clay and sand, and clay and rock, occur only in minute quantities.

The other two major temper categories - chaff and laterite - increase in frequency of occurrence through time. Chaff, which occurs quite uniformly in the early layers in amounts under 10%, increases markedly in the upper two layers to over 27% in layer 1. Low-fired soft chaff ware containing a moderate amount of coarse fibre predominates until layer 5, then is replaced by hard chaff (high-fired sherds containing a smaller amount of fine fibre). Other chaff tempers are minimal. Laterite temper, seemingly never popular, was found in small amounts in all layers except layer 1 and reaches a peak in layer 3. Laterite only is the most common, with

tiny amounts of laterite and sand, and laterite and clay occurring in some layers.

A total of 248 rim sherds came from the site. None were present in layer 1, while layers 7 and 8 contained 11 and 3 sherds respectively. In respect to form, the majority of rims (approximately 53% by number), had to be classified as 99 (indeterminate) so that any conclusions had to be reached on the basis of the remaining identifiable forms and are therefore only tentative. The variety characteristic of temper type is also present in rim forms, in this case becoming marked in layer 5, where the number of forms present is double that of the preceding layer, and becomes slightly less in subsequent layers. The only form to appear in all layers is type 05, a straight, or slightly inverted rim belonging to a bowl; this is most numerous in layer 6. Other bowl-like rims - 06 and 16 - occur in the upper layers. Variants of the straight vertical rim (01, 02, 07) are found in all layers except 8. Other rim forms apparently came into favour for a relatively short period of time, then disappear, to be replaced with alternative ones, although the small sample precludes stating this as a definite conclusion.

By far the majority of the rims are plain-surfaced - that is, beyond initial smoothing to eliminate irregularities, no further treatment has been given to them. Small amounts of red slip, polish, and both red slip and polish occur on the outside and the inside of some rims.

Few rims are incised or impressed. Most incision or impression is on the outside of the rim. It is tempting to postulate a progression from incised crosshatched decoration (layers 6 and 7) to incised straight line decoration (layers 3 - 5), but the small number of sherds involved make this very tentative.

Shoulder surfaces are mainly plain. The most common decoration is cord-marking, the widest variety occurring in layers 4, 5 and 6, where small amounts of unidirectional cord-marking (diagonal and horizontal) and of type 25 (crosshatched, with an angle between 45 and 80 degrees) occur along with the predominant crosshatched type. Smoothed-over cord-marking is present in layers 5, 6 and 7. One sherd in layer 5 has a brown slip applied over the smoothed cord-marks. Incision or impression other than cord-marking is rare; again a progression from incised simple decoration to incised straight lines could be postulated. The only applique decorations present are a single nubbin found on two sherds, one in layer 3, the other in layer 4.

The pattern of body finish at the site is one of alternating predominance of two major types - plain finish and cord-marking. A wide variety of others is present in much smaller quantities, especially towards the middle of the sequence. It is apparent that the popularity of the two finishes fluctuated throughout the sequence. Thus, cord-marking, which has been predominant in layers 6 and 7 drops significantly in

layer 5, and is replaced by a greater amount of plain surfaced ware. Plain finish drops again in layer 4, in favour of cord-marking after which the latter decreases steadily throughout the rest of the sequence, as plain increases equally as steadily. The occurrence of crosshatched cord-marking (40.5% of the total body decoration) is more frequent than that of unidirectional cord-marking (18.6% of the total body decoration). Smoothed-over cord-marking decreases toward the upper end of the sequence. Small quantities of red slip (02) and polish (03) are found in layers 2 - 7, and minute quantities of other slipped ware in layers 3 - 6. Impressed decoration, executed with a simple tool, is present throughout the sequence, ignoring layer 8. No incised designs occur.

Three foot sherds were found. The form of one hard sand-tempered sherd in layer 7 could not be determined. It was plain on both inner and outer surfaces. The layer 5 sherd, tempered with sand, was of a conical form, and was also plain-surfaced both inside and out. The third foot sherd, in layer 2, was tempered with sand and laterite and was part of a flared pedestal with circular cutout perforations. Both surfaces were plain.

The remains of the six pots found in burial 1 were restored, five of them completely, one partially. (See Appendices III and IV.) Each pot is described below.

Pot 1: (NNC - 1):

A relatively small, squat, hard sand-tempered pot, 16 cm high and 16 cm across at its widest part. Its rim is of form 29 (see Appendix I), is 33 mm high, and is plain both on the inside and the outside. The diameter of the rim across the mouth of the pot is 15 cm and that at the point where the rim meets the body was 13 cm. No distinctive treatment of the shoulder had been made. The body is round-bottomed and spherical, with a crosshatched cord-marked decoration of type 25 (angle 45 - 80°). Average thickness of the body wall is 5 mm. No great care has been taken in the surface treatment of this pot; the cord-marking has been unevenly applied, and horizontal grooves are apparent where the rim has been smoothed. A wide scar on the base apparently resulted from breakage during firing. Colour ranges from orange to buff, with numerous black fire clouds on the surface. The inside of the pot is uniformly black.

Pot 2: (NNC - 2):

A large round-bottomed, ovoid bodied pot 39 cm in total height, and 35 cm wide. One side of the pot is missing although a complete profile was obtained. It is sand-tempered, and like pot 3 has a plain rim of type 19, which was 18 cm in diameter, 17 cm at the body, and 30 mm high. The shoulder was again not given

special treatment, and the body was decorated with crosshatched cord-marking of type 25. Average thickness of the body wall is 6 cm. Again colour ranged from orange to buff with large areas of fireclouding.

Pot 3: (NNC - 3):

A much larger pot (39 cm in height, 35 cm at its widest part), with a round-bottomed ovoid body, and a rim of type 19. Rim diameter is 18 cm, and rim width at the body 17 cm. The rim is plain on both inner and outer surfaces, and the body decoration is crosshatched cord-marking of type 25. The average thickness of the body wall is 6 mm. No shoulder demarcation is present. More care had been taken with the surface treatment of this pot; cord-marking is finer and the rim well smoothed. Colouring is identical to that of pots 1 and 2. Decoration had been carefully executed and the rim well-finished.

Pot 4: (NNC - 4):

This is the partially reconstructed base of a small, round-bottomed spherical pot, and does not represent a complete reconstruction. Maximum width of the pot is 16 cm, and average thickness of the body wall 6 mm. Type 25 crosshatched cord-marking covers the body. Remnants of a plain smoothed shoulder are present. The colour ranges from a dark to a yellow-brown and fireclouds occur.

Pot 5: (NNC - 6):

A small squat pot, 11 cm in total height, and 13 cm in maximum width, with a round-bottomed spherical body, and a plain rim of type 13. Rim diameter is 14 cm, 11 cm at the body and rim height 20 mm. This ware is quite different to that of the other pots in burial 1. The tempering material consists of ground-up fired potsherds, and the body is decorated with smoothed-over cord-marking of type 40 (undifferentiated). Average thickness of the body is 6 mm. There is no shoulder. The pot itself has a crude unfinished look with irregularities in both rim and body. Its colour is basically buff, but large areas of fireclouding are present on the body.

Pot 6: (NNC - 12):

A large finely-made pot, uniformly black in colour, and 37 cm both in total height and maximum width. The type 37 rim (28 cm in diameter, 27 cm at the body, and 8 mm in height) has been polished. Immediately below the point where the rim joins the shoulder, a red-painted design of 4 parallel lines extends around the circumference of the polished rim. Diagonal strokes in red paint join the middle two lines. Beneath this, 5 parallel incised lines run around the pot. The raised ridge left between each is decorated with diagonal incised strokes. The round-bottomed ovoid body is covered with fine cord-marking

of type 25. The interior is an even grey in colour. The ware is hard, and quite thin, given the large size of the vessel, especially on the bottom of the pot. Average thickness of the body wall is 5 mm.

A great deal of consistency is apparent among the pots from Burial 1. With the exception of Pot 5, the wares have a similar appearance, the tempering material is hard sand, and body finish is uniformly type 25. A division appears to exist between the large pots with conical bodies and the small ones with spherical bodies. In addition, large pots 2 and 3 have rims of type 19. Pot 6 stands apart from the other pots in that care has been taken in its manufacture and decoration. It may be that this pot was specially constructed for inclusion in the burial. The appearance of all the other pots, however, suggests that they were domestic ware.

DON SAWAN

Unlike Non Nong Chik, little variety in temper is found. Especially marked is the absence of combined tempers - that is a major tempering material plus one or more minor temper inclusions. Sand temper, consisting almost entirely of hard sand, predominates by a very large margin, but in general decreases at the upper end of sequence. Chaff temper, mainly hard chaff,

displays several minor peaks of popularity in layers 12, 8 and 5; these are paralleled by similar drops in the occurrence of sand temper. Chaff temper then rises sharply in the upper four layers, while sand temper drops accordingly. Prepared temper, represented entirely by prepared clay temper, increases along with chaff in layer 12, thereafter to decline until its disappearance in layer 9. Laterite temper appears in layer 12 and steadily increases throughout the sequence, where it is notably more common than at Non Nong Chik.

Don Sawan was the only site to contain ceramics other than earthenware; although only a few pieces were found. One sherd of true porcelain was found in layer 1 and another in layer 2. Both were partly glazed with a colourless glaze. The glaze on the sherd in layer 2 was transparent. Four pieces of semi-vitreous proto-porcelain were present, one in each of the first four layers. All were partly glazed with a pale green glaze, that of the sherd in layer four being transparent. There were six sherds of stoneware in layer 2. Three contained a minute amount of sand temper. Two of these were unglazed, the other had a brown glaze. The remaining three stoneware sherds, all unglazed, contained a moderate amount of sand temper. By far the most rim forms (well over 50%) were classified as type 99, leaving comparatively few identifiable rims for study. Type 99 accounts for all rims in layers 11 and 13 while layer 12 contained no rim sherds at all.

Consequently, rim form trends in the early part of the sequence cannot be determined. The range of rim forms present is not nearly as wide as that at Non Nong Chik. Some continuity is apparent in type 05 (which occurs in layers 1, 4 and 7), and in straight rim form types (01 and 02). For the remainder no rim form is repeated, suggesting minor utilization of a number of local or imported types for short periods of time, while general types continue in popularity over time.

The majority of the rims are plain-surfaced, both inside and outside. For the remainder, represented by only small amounts, more consideration seems to have been given to outer rim finish than to that of the inner rim. Polished rims, both outside and inside, occur in layers 8 and 9. Red slip appears on the outside of some rims in layer 8, and on both inner and outer rim surfaces in layer 7, where one sherd with a simple curved line pattern on dark paint on the outside of the rim was also found. Only one incised sherd came from the site, in layer 3. The decoration consisted of straight lines incised freehand on the inside of the rim.

Shoulder sherds at the site are mainly plain-surfaced. The remainder are cord-marked. Cord-marking, both unidirectional and crosshatched, begins in layer 7 and continues in relatively small amounts throughout the rest of the sequence.

The relationship between plain and cord-marked body surface treatments apparent at Non Nong Chik is

also present at Don Sawan. Fluctuations in one site are in general paralleled by fluctuations in the other. Thus, relatively major amounts of cordmarked ware occur in layers 13 and 7, and plain surfaced ware is present in only minor quantities, paralleling layers 6 and 4 at Non Nong Chik. Conversely, peaks in the incidence of plain ware in layers 9 - 12 and layer 2, and consequent decreases in cordmarking (see Figure 3.) resemble the pattern for layers 5 - 6 and 1 - 2 respectively at Non Nong Chik. Cordmarking decreases in general towards the upper end of the sequence, as plain ware rises. Cross-hatching occurs considerably more frequently than unidirectional cordmarking in layers 9 - 13 and in layer 7. Unidirectional cordmarking is represented almost entirely by type 20 (unspecified unidirectional cord-marking); that is, no features (for example shoulder demarcation) were present to enable the sherds to be oriented so that the direction of the cordmarking could be determined. A small amount of cordmarking of type 27 (not crosshatched but oriented in several different directions) is present in the upper layers. All three types of crosshatched cordmarking were found. Type 26 (angle more than 80^{o}) appears in layer 13, type 25 in layer 12, and type 24 (angle less than 45^{o}) in layer 10. All subsequently decrease. Overall, smoothed-over cordmarking decreases through time. Small amounts of red slipping, and small amounts of polishing occur throughout. Three sherds with a decoration which had

been impressed with a simple tool occur in layer 11. The design was one of circles which appeared to have been impressed into the wet clay with a hollow instrument such as a straw. The remains of the decoration on the sherds indicated that the circles were arranged to form what appeared to be a branching meander pattern.

Three foot sherds came from the site, one from each of the upper three layers. The earthenware sherd in layer 3 had a hard sand temper, and was plain on both outer and inner surfaces. It was too incomplete to allow foot form to be determined. The layer 2 sherd was porcelain, partly glazed with a colourless glaze, and was plain-surfaced both inside and outside. It had formed part of the base of a foot around which were two, possibly more, applique ridges approximately 1 cm in diameter. From layer 1 came an almost complete porcelain foot, partly glazed with a colourless transparent glaze. Eight cm in height, and of a low vertical form, it had traces of a dark-painted design of straight vertical lines around the base.

DON WAT KAO

Significantly fewer sherds were recovered from Don Wat Kao than from any other site, making interpretation rather inconclusive. No ceramic material worth analysing was recovered from layer 4, leaving a gap in the sequence.

It is possible that the site was abandoned during this time. However, given the fact that a minimal amount of damaged cultural material was found and since the percentages of the pottery attributes in the layers on either side make continuity likely, it seems possible some other factor, perhaps flooding of the site, was responsible for the dearth of cultural material. Nevertheless, analysis of the few sherds present revealed trends similar to those at Non Nong Chik and Don Sawan.

Assuming continuity through layer 4, sand temper decreases steadily towards the top of the site, as chaff temper increases. Soft sand temper occurs in larger proportions in this site than in any other. The proportion of hard sand is higher than that of soft sand in layers 2 and 6, while soft sand is predominant in layer 1 and in layers 3 and 5. A small amount of sand and gravel temper occurs in layer 5. Little can be said of prepared temper since so few sherds of this type were present. Numbers are relatively even throughout. One sherd with laterite and sand temper was found in layer 5.

The rim form analysis was inconclusive. No rim sherds were found in layer 2, 4 and 6. One untypable rim was found in layer 1, and 4 in layer 3. In layer 5 were four indeterminate rims of type 99 and one rim of each of types 05, 06 and 58.

All rims were plain on both their outer and inner surfaces, except for one in layer 5 which was red slipped on the outside. No incision or impression occurred.

In layer 2 was found the only shoulder sherd to be recovered from the site. Its surface was too eroded to allow identification of surface treatment.

The analysis of body surface treatment was much more conclusive. As in the above two sites, plain-surfaced ware increases through time as cord-marking decreases. Unidirectional cord-marking, never as common as crosshatched cord-marking, is present in layers 3, 5 and 6 and one sherd of type 25 occurs in layer 1. Small quantities of smoothed-over cordmarking were found in layers 3, 4 and 6; the one sherd in layer 3 has red slip applied over the cord-marking. One sherd in layer 1 has been polished over a simple dark-painted design of wide curved bands. No foot sherds were recovered.

DON KOK.

Sand is by far the most significant temper type present. Hard sand predominates over soft sand throughout, and increases towards the end of the sequence. The use of laterite as a tempering inclusion is especially marked. It occurs in minor amounts in a temper predominantly of sand to form the major temper type in layers 3, 4, 5 and 6. In layer 2, when the amount of sand and laterite temper declines, the rise in laterite only as a tempering material is sharp. The amount of chaff temper present is minimal. It occurs in its largest amounts combined with

laterite in layer 1. Prepared temper is present in small amounts in all layers except layer 1 and rises slightly in layer 2.

No rim sherds were recovered from layer 5. The remainder are mostly of type 99. The only continuations are of type 37 in layers 3 and 6, and of type 13 in layers 3 and 5.

Most rims are plain-surfaced. Minute amounts of red slip finish on both outer and inner rims, and of polishing on the outer rim occur in layer 3. In layer 6, some polishing occurs on both surfaces (2 polished inner rims and one polished outer rim). No sherds were incised or impressed.

Seven pieces of shoulder are represented in the mixed sherds in layer 3. Four are plain-surfaced, one is decorated with smoothed-over cordmarking, while on the remaining two surface treatment could not be determined owing to surface damage.

The pattern of surface treatment of the body is again one of decreasing cordmarked and increasing plain-surfaced sherds as the sequence progressed. Peaks in the occurrence of plain-surfaced sherds and complementary declines in cord-marking are present in layers 2, 4 and 5. A higher percentage of cross-hatched cordmarking as opposed to unidirectional cordmarking is apparent. In layer 3 were three sherds of red-slipped ware. Polishing, present in quite small amounts in layer 6, reappears in layer 2 and continues into layer 1.

Parts of four pots were reconstructed (see Appendices III and IV). Two of the pots provided complete reconstructions; the remaining two could only be reconstructed partially.

Pot 1, (DK - 1):

A large pot, partially reconstructed and tempered with sand and small laterite lumps with most of the body missing. The rim (form 13) has traces of polishing on both the inner and the outer surfaces; has a lip diameter of 21 cm, a diameter at body junction of 18 cm, and a height of 50 mm. The rim is set at an angle of about 45^{o} to the shoulder, which is also polished and has a width of 9 cm. Since not all of the body could be reconstructed, neither body form nor total height of the pot could be determined. However, sufficient remained to indicate that the maximum width of the vessel (33 cm) occurs immediately below the shoulder. Cross-hatched cordmarking of type 26 (angle close to 90^{o}) covers the body portion of the pot. The colour over all parts of the pot is dark red. Average thickness of the body wall is 4 mm.

Pot 2, (DK - 2):

A large sand and laterite-tempered bowl of soft friable ware with ring foot. The body of the bowl is basically grey in colour with numerous orange patches, while the ring foot is coloured uniformly orange. The

rim of form 06 has evidences of polishing on its inner and outer surfaces, a diameter of 21 cm, and width of 22 cm, and a height of 25 mm. The body is regularly hemispherical in shape. Its surface treatment has been described as plain, but because of the eroded surface of the ware it is likely that a polished finish was originally present over the whole body, although only traces remain on the rim. Average thickness of the body wall is 5 mm. The foot, which had been applied after the body of the bowl had been completed, was classified as a pedestal since its height (18 cm) comprised over a third of the total height of the vessel (22 cm). Its sides are slightly concave and flared a little towards the base. No decoration is present. The diameter across the base of the foot is 14 cm, and the width where the foot met the body is 6 centimeters. Maximum width of the vessel is 22 cm.

Pot 3, (DK - 3):

A small, red, hard sand-tempered pot with a round bottomed spherical body. The rim form is of type 13 and both surfaces of the rim have been well-smoothed, but not polished. Rim diameter is 17 cm, rim diameter at body 13 cm and rim height 31 mm. The shoulder, which meets the rim at an angle of 45^{o}, is 4 cm high and has also been well-smoothed. Width of the shoulder from rim to body (shoulder width) is 3.5 cm. The body decoration is cross-hatched cordmarking of type 26. Total height

of the vessel is 14 cm, maximum width is 15 cm, and average thickness of the body wall is 3 cm.

Pot 4, (DK - 15):

Only part of one side of this pot could be reconstructed so that body form, shoulder width and total vessel height could not be determined. Judging by the fragment present, however, it seems that the dimensions of the pot were quite large. The tempering material is soft sand, and small laterite lumps, making the ware rather friable. The rim is of type 37 form, has a diameter of 32 cm at lip and 31 cm at body, and a height of 9 centimeters; it is plain both inside and outside. The shoulder is formed by four parallel incised lines running around the circumference of the pot, with diagonal incised dashes on the ridges between them. The body decoration is cross-hatched cordmarking of type 24 (angle less than 45^{o}). The sherds are black in colour. The remains of this pot bear a great deal of similarity to Pot number 5 from Non Nong Chik in rim form, shoulder decoration, and general appearance of the ware.

In general, the Don Kok pots are much more finely made and carefully decorated than those at Non Nong Chik, and are not so obviously domestic ware. All are from layer 5, except for pot 4 which came from layer 6.

CHI-SQUARE TESTS OF ASSOCIATION

As mentioned previously, because of insufficient data, chi-square tests of association could only be performed on one pair of variables: temper type and body decoration. For the same reasons not all layers in the four sites could be tested. However, the majority of the results showed a definite association between the two variables.

From the site of Non Nong Chik, all layers except layer 8 were tested, and of these, all but layer 7 gave highly significant results at the 0.05 level within two degrees of freedom. This was partly because chaff temper, present in all layers tested, nearly always occurred with plain-surfaced ware. Prepared temper and plain finish were also found predominantly together, particularly in layers 4, 5 and 6. In general sand temper is associated most frequently with cordmarked decoration, except in layer 3, where various types of sand temper tend to be spread equally between plain and cordmarked finishes. The proportion in which hard sand temper occurs with cross-hatched cordmarking in layers 2, 4, 5 and 6 is worth noting. In layer 5, soft-sand temper occurs very often with a plain surface. Laterite temper is present in significant amounts in layer 3 only, where it is frequently associated with cross-hatched cordmarking.

Only ten of the thirteen layers from Don Sawan were suitable for testing (layers 1 - 4, 6 and 7, and 9 -

12). The results from all layers tested, except layers 7, 10 and 11, were again significant at the 0.05 level within two degrees of freedom, demonstrating a high degree of association between temper and body decoration at this site as well. The association between chaff temper and plain body finish is much more marked than at Non Nong Chik, and in the main accounts for the highly significant results. In layers 1, 9 and 12, chaff temper never appears in anything other than plain-surfaced sherds. The association between sand temper and cordmarking is not as secure as at Non Nong Chik. Sand temper is found more often with cordmarking than with any other temper type in layers 1, 6 and 12. In the remaining layers, sand temper is divided quite evenly between plain and cordmarked body finishes, except in layer 2 where it is most commonly apparent in plain ware. Laterite temper occurs consistently with cordmarked decoration. Prepared temper, present in small quantities throughout the sequence, is encountered more often in plain-surfaced sherds than otherwise.

Tests of the Don Wat Kao material yielded results significant at the 0.05 level in layers 5 and 6 only. Layer 3 was also tested, but did not provide significant results. Chaff, soft sand, and prepared tempers appear most frequently with a plain surface, while hard sand occurred most often with cordmarking.

Both layers tested at Don Kok (layers 2 and 3) gave highly significant results at the 0.05 level. In layer 2, hard sand temper, along with prepared temper

is found markedly more often with plain finish than with cordmarking, while soft sand is present in approximately equal proportions with both plain finish and cordmarking. Laterite temper on the other hand occurs exclusively with cordmarking. In layer 3, the results are highly significant because prepared temper occurs nearly always with plain finish. All other temper types are spread relatively evenly among the body decorations.

CHAPTER 5

CONCLUSIONS

From the results obtained in this study in conjunction with material from the Non Nok Tha 1968 excavations, it was possible to formulate a ceramic sequence for the Phu Wiang area - one of the first such areal sequences established in Southeast Asia. The sequence, outlined below, is based primarily on similarities in percentage distributions of attributes in the sites concerned. The simple seriation methods employed were considered to be justified since as analysis of the data progressed it became clear that the drawbacks of many seriation studies discussed in Chapter 1 were not applicable in this case. Additional justification was provided in the close proximity of the four sites to one another, and to Non Nok Tha. The results of analysis of material from Non Nong Chik, Don Sawan, and Don Kok made correlations between them

quite apparent. Don Wat Kao, however, could not be placed in the sequence with such a high degree of certainty, partly because of the lack of data and partly because the gap in layer 4 made interpretation difficult. Temper type and body surface treatment provided the basis for correlations between layers. Other attributes, where significantly represented, tended to support trends indicated by the two major variables.

Most noticeable is the predominance of sand temper and its gradual decline, along with cordmarking, towards the upper end of the sequence at all four sites (see Figures 3 and 4). Equally apparent was the rise in chaff temper and plain body finish in upper layers. At each site, prepared temper and laterite temper occupy approximately the same time span and exhibit the same pattern of development - prepared temper declines over time and laterite temper rises, although both remain small minorities.

Layer 6 at Non Nong Chik, Layer 13 at Don Sawan, and Layer 6 at Don Kok are approximately equivalent. Cordmarked body finish predominates, and the ratio between it and plain finish is similar at all four sites. A rise in the occurrence of cross-hatched cordmarking as opposed to unidirectional occurs in all three layers. Predictably, sand is the major temper type present; the amount of chaff temper is only small. In each case, prepared temper is present in relatively high amounts. Layers 7 and 8 at Non Nong Chik thus predate the bottom

layers of the other sites.

The marked rise in the percentage of plain body finish at the expense of cordmarking in Non Nong Chik layer 5, is equivalent to a similar occurrence in Don Sawan layers 9 - 12, and Don Kok layers 4 - 5, making it likely that these layers occupied the same time span. The drop in sand temper along with cordmarking especially apparent at Non Nong Chik and Don Sawan is accompanied by only a small rise in chaff temper, indicating that a large number of plain-surfaced sherds in these layers are sand-tempered. A small rise in the use of polish and of red slip as body decoration in the four layers at Don Sawan, and the single layer at Non Nong Chik, as well as an increase in the percentage of polished rims in Layer 5 at Non Nong Chik, Layer 9 at Don Sawan and Layer 4 at Don Kok help to establish the validity of the comparison. Moreover, at Non Nong Chik and Don Sawan, a notable increase in the variety of rim forms occurs at about this time.

The subsequent rise of cordmarking to a position of major surface finish once again, and a corresponding drop in plain finish are represented in Non Nong Chik Layer 4, Don Sawan Layer 7, and Don Kok Layer 3. These are accompanied by the continuing predominance of sand temper, and a slight decrease in chaff temper apparent at Non Nong Chik and Don Sawan. It appears that Layer 8 at Don Sawan falls somewhere between Layers 4 and 5 at Non Nong Chik, and Layers 3 and 4 at Don Kok.

Similarly, Layer 6 at Don Sawan can be placed between layers 3 and 4 at Non Nong Chik, since similar percentage distributions of attributes appear in Non Nong Chik Layer 3 and Don Sawan Layer 5. On the same grounds, the bottom layer at Don Wat Kao (Layer 6) is equivalent to these two. The level of cordmarking is beginning to drop once more, and a rise in plain finish, is becoming apparent. Chaff temper is beginning to rise at Non Nong Chik and Don Sawan, while laterite temper is present in relatively equal proportions.

By the time of Layer 2 at both Non Nong Chik and Don Kok, the percentage of occurrence of ware with a plain body finish has reached a point where it is once again a little higher than that of ware with a cordmarked body decoration. A rise in the percentage of unidirectional cordmarking at the expense of cross-hatched is also apparent. A small drop in sand temper occurs at both sites accompanied by a peak in chaff temper at Non Nong Chik - the latter largely due to the strong association between chaff temper and plain body finish. On the basis of body surface treatment in particular it is most likely that Layer 4 at Don Sawan belongs in the sequence just before, and Layer 3 just after Layer 2 at Non Nong Chik.

A great deal of similarity in attribute percentages exists between Layer 1 at Non Nong Chik, Layer 1 at Don Kok, Layer 2 at Don Sawan, and Layer 2 at Don Wat Kao. Plain body finish is predominant over

cordmarking by a large margin. The decrease in sand temper is most marked at Don Sawan. Chaff temper rises quite noticeably in all sites except for Don Wat Kao where the lack of any chaff-tempered ware is no doubt due to the small number of sherds (eight) present in this layer. Certainly the overall trend at the site is towards a gradual increase in chaff temper over time. Laterite temper (where present) and prepared temper have undergone a decrease except in the case of the latter at Don Sawan, where its last appearance was in Layer 9. Layers 3, 4 and 5 at Don Wat Kao seem to reflect well the rise in plain finish and the decline in cordmarking apparent between Layer 1 and 2 at Non Nong Chik and Don Kok and Layers 3 and 4 at Don Sawan.

Layer 1 at both Don Sawan and Don Wat Kao are similar in some respects - plain finish has dropped somewhat while a rise in cordmarked decoration is particularly marked at Don Sawan. Notable too is the increase in cross-hatched cordmarking, while unidirectional cordmarking decreases. As far as temper is concerned, however, the drop in chaff temper and rise in sand temper present at Don Sawan is not paralleled at Don Wat Kao. It seems probably, therefore, that Don Sawan Layer 1 is a little later in time than Layer 1 at Don Wat Kao.

The validity of the early portion of the sequence is in part borne out by the earliest evidence for the use of iron at Non Nong Chik (several pieces) occurring in

Layer 6. If the correlation between Non Nong Chik Layer 6, Don Sawan Layer 13, and Don Kok Layer 6 is correct, and if Don Wat Kao does occur as late in the sequence as ceramic evidence would suggest, this would place the other three sites within the iron period, and support the impression of the excavators that iron was present throughout the history of both Don Sawan and Don Kok (Higham and Parker, 1970: 38, 42-43). The earliest evidence for actual iron-smelting (numerous pieces of slag) is in Layer 5 at Non Nong Chik. The presence of iron slag in Layer 6 at Don Sawan represents the earliest evidence for iron at this site and could suggest that iron was used but not produced at an earlier date. It occurs as early as Layer 4 at Don Kok, and its presence in Layer 5 at Don Wat Kao supports the position of this site in the sequence.

Non-earthenware ceramics were found only in the upper four layers of Don Sawan. On the basis of the postulated sequence, if any are present in the other three sites, the introduction would have occurred before Layer 2 at Non Nong Chik and Don Kok and just after Layer 6 at Don Wat Kao. The time span of stoneware and porcelain coincides with that for evidence of cremation burial at Don Kok, suggesting a joint introduction of non-earthenware ceramics and cremation at the same time, iron having been introduced independently at an earlier date.

Of the six carbon dates from Non Nong Chik,

three support the sequence well. The date of 2830 ± 105 BP for Layer 7 places the earliest occupation of the site before this time, but perhaps not so early as the 3580 ± 95 BP date from this same layer would indicate. The post layer 6 date has already been mentioned. The date of 2120 ± 75 BP obtained from Layer 5 at Non Nong Chik serves to indicate the age of Layers 9, 10, 11 and 12 at Don Sawan, and Layers 4 and 5 at Don Kok.

It was not possible to arrive at an objective typology for the Phu Wiang ceramics, primarily because chi-square association tests could be performed for only one pair of variables; neither did the number of reconstructible vessels constitute a sufficiently large sample to enable any conclusions to be reached. The definite association between chaff temper and plain finish, and between sand temper and cordmarked decoration, indicates no more than that throughout the history of all four sites, most chaff-tempered ware was not decorated, and most sand-tempered ware was cordmarked. While the reconstructed vessels from Non Nong Chik and Don Kok bear out this association, the division postulated in Chapter 4 between the large conical-bodied pots, and the smaller ones with spherical bodies, at Non Nong Chik can only be regarded as very tentative given the sample of just six vessels.

In general, the results of the analyses of ceramic data and the sequence of radio-carbon dates from Non Nok Tha (Bayard 1971) can be incorporated quite

successfully into the Phu Wiang sequence. The overall decline in sand and prepared tempers along with cordmarked body decoration through time found at the other Phu Wiang sites is also present at Non Nok Tha. So too is the increase in chaff temper and plain body finish towards the upper end of the Non Nok Tha sequence. The early portion of the sequence from Non Nok Tha can be included on only tentatively, however, due to the fact that ceramic data from MP6, 7 and 8 have not been analysed. The marked predominance of sand temper and cordmarking in MP 5 seems to represent a point in time before the beginning of the decline in these two attributes which culminates in the ascendency of plain finish in Non Nong Chik Layer 5 and equivalent layers in other sites. This trend, and the two radio-carbon dates from MP 5 (3090 $\pm$ 120 BP and 2990 $\pm$ 110 BP) suggest that this level is somewhat earlier than Layer 7 at Non Nong Chik, but perhaps not as early as Non Nong Chik Layer 8.

The resumption of the ceramic sequence at Non Nok Tha in LP2 reveals a continued predominence of sand temper and cordmarked body finish, and a relatively high percentage of smoothed-over cordmarking as a body finish compared with subsequent levels. Similarities in attributes at the other four sites taken in conjunction with an extrapolation back from the available L.P. 2 data suggests that Non Nok Tha L.P. 1 could most likely be placed between Layers 3 and 4 at Non Nong Chik, just above Layer 3 at Don Kok, and is most similar to

Don Sawan Layer 6. The pattern of decline in cordmarking, the slight drop in sand temper, and the rise in plain finish in L.P. 2 at Non Nok Tha indicate that it should be placed just after Layer 3 at Non Nong Chik, but not quite as late as Don Sawan Layer 4. Similarly, in the predominance of plain body finish and chaff temper now present L.P. 3 seems to have been occupied somewhere between the Layer 1 and 2 occupations at Non Nong Chik and Don Kok and is perhaps equivalent with Don Sawan Layer 3, and Layers 2 or 3 at Don Wat Kao. The radiocarbon dates from L.P. 2 and L. P. 3, 710 $\pm$ 90 BP and 500 $\pm$ 85 BP respectively, place this portion of the sequence well within the historic period. Viewing the magnitude of the continuing rise in the incidence of plain finish and chaff temper, and the complementary decline in cordmarking and sand temper in L.P. 4, this would seem to tie in best with the peak in plain finish and chaff temper in Layer 2 at both Don Sawan and Don Kok, and consequently became equivalent to Non Nong Chik Layer 1. In any event, it is not feasible on the grounds of the ceramic data to place it before any of these layers.

Some support is gained for the incorporation of L.P. 1 - 4 at Non Nok Tha into the upper part of the Phu Wiang sequence by the presence of stoneware and porcelain down as far as Non Nok Tha L.P. 2 which on the basis of evidence from earthenware ceramics was placed just before Don Sawan Layer 4, where the earliest

non-earthenware ceramics at this site occurred.

Thus, the gap in the Non Nok Tha sequence can be spanned satisfactorily with the data from the Phu Wiang sites. In the light of the evidence for cremation burial in the upper two layers only at Don Kok, the appearance of this practice at Non Nok Tha in L.P. 1, immediately after the gap may well represent the introduction of cremation into the area, since L.P. 1. has been placed earlier in time in the combined sequence than Don Kok Layer 2. The introduction of iron into Non Nong Chik at the time of Layer 6 is not paralleled by its appearance in M.P. 7 and M.P. 8 at Non Nok Tha as might be expected, since the ceramic data suggests that these two levels apparently post-date Layer 6 at Non Nong Chik. Iron first appears along with cremation burial in L.P. 1 at Non Nok Tha, which would lend support to Parker and Bayard's hypothesis that the massive introduction of iron occurred during the period represented by the gap in the 1968 sequence (Solheim, Parker and Bayard, 1966: 61); however limited quantities of iron may very well have been present but not retrieved during the MP 7 - 8 period.

It is apparent that during the time represented by the sequence, at least, the five sites were inhabited by groups of people carrying out similar activities at similar times who were obviously in close contact with one another. A bronze period, represented by Non Nong Chik Layers 7 and 8, and by MP 5 and 6 (and possibly MP

7 and 8) at Non Nok Tha, which began at the end of the third millennium B.C. was followed by the initial introduction of iron possibly somewhat before 390 ± 16 B.C. at Non Nong Chik, Don Sawan and Don Kok, and perhaps at the same time or a little later at Non Kok Tha. The appearance of considerable variety in ceramic attributes in Layer 5 at Non Nong Chik, Layers 9 - 12 at Don Sawan, and layers 4 - 5 at Don Kok, could be explained by a florescence in iron-working at this date (70 ± 75 B.C.), perhaps associated with the introduction of new ceramic influences through associated trade with other areas. Such contacts would certainly have offered increased opportunitites for the percolation of other items into the area; in particular, the Non Nong Chik Layer 5 date would lend support to the probability of the arrival at this time of Indian influences, including Mahayana Buddhism and Brahmanism first present in other areas of Thailand in the early part of the first millennium A.D. Nor does the continuation of inhumation burial above this level in the sequence detract from this view since today many Mahayana Buddhists do not practice cremation.

In case of Theravada Buddhism, however, cremation is practically universal in those areas of Southeast Asia where it is predominant, so that the presence of cremation burials from Layer 2 on at Don Kok and from LP 1 upwards at Non Nok Tha would strongly suggest that this form of Buddhism was introduced at

this stage, apparently accompanied by the first introduction of non-earthenware ceramics. The date from Non Nok Tha LP 2 of 710 ± 90 B.P. correlates with the historically known introduction of Theravada Buddhism into the Laos - Khorat area in the thirteenth century A.D. (Briggs, 1951: 254).

Relationships of the sequence to sites outside the immediate area are difficult to determine. In particular, the four sites inside Phu Wiang mountain, while obviously part of a general mainland, Southeast Asian ceramic tradition in respect to manufacture, decoration, temper and vessel form, do not display obvious similarities to any specific site. Some tentative parallels can be made between Non Nok Tha and sites both within and outside the Khorat plateau, but these are mainly in respect to the distinctive painted and slipped wares or to bronze and iron artifacts not found in the test excavations inside the mountain. Clay-tempered red-on-white painted ware, common to the bronze and iron-bearing layers at Ban Chiang, in many respects resembles rare finds of similar ware found at Non Nok Tha levels E.P. 3 and M.P. 1 - 2. The predominant ware in the Bronze period layers of the Phu Wiang sites, however, is sand-tempered and cordmarked, alternating in the Iron period with plain-surfaced chaff-tempered ware. Cordmarking as a major decorative style is found only in the pre-metal 'Neolithic' layers (4 and 5) at Ban Chiang (Nikhom, 1972). A thick light-surfaced

sand and fibre-tempered ware predominant in the middle layers at Ban Sao Lao (Lam Pao 3), (Solheim, Parker and Bayard, 1966: 87), is also present in the Late Period at Non Nok Tha. In addition, an increase in the number of imported earthenware sherds and the appearance of non-earthenware pottery in the Ban Sao Lao layers equates with similar trends in the Phu-Wiang-Non Nok Tha sequence, and indicates that the former site fits generally into the latter (post -1200 A.D.) part of the Phu Wiang sequence.

Further afield, parallels have been established between burial pottery at Kok Charoen and in the early Middle Period at Non Nok Tha (Watson, 1968: 304). Bayard (1970) points to resemblances between Non Nok Tha Middle Period bronze artifacts and axe moulds and those from Mlu Brei (Levy 1943) and the site of Hang Gon in South Vietnam (Saurin, 1968). He also notes the similarity of some Middle Period vessels to pottery types 2, 18, 20, and 22 in Sørensen's typology of the Ban Kao ceramics (Sørensen and Hatting, 1967). It is noteworthy here that the sand-tempered pedestalled bowl with the incurved rim from Don Kok Layer 5, shows affinities in many respects with the type 2 vessels from Ban Kao (Sørensen and Hatting 1967: 90 - 91), bearing in mind that in the proposed sequence, Layer 5 at Don Kok falls within the time occupied by the late Middle Period levels at Non Kok Tha; these are presumably equivalent in general to the iron-period cemetary at Ban Kao.

The parallels outlined above between the sequence

and other sites suggest that outside contact was never of a far-reaching or long-standing nature. A strong impression is gained from ceramic and related evidence that the five sites under consideration represent a fairly close-knit but isolated cultural unit within a more wide-spread cultural tradition, which received influences from other areas only sporadically. Little outside contact is apparent until the introduction of cremation, stoneware, and porcelain, and even this contact seems to have been limited, judging from the small amounts of trade ceramics recovered from the sites. In fact, the Phu Wiang region continued to be very isolated through the first half of the present century. This continued until the construction of an all-weather road during the 1960's allowed more easy access to the provincial capital of Khon Kaen. Even now the area is far removed from the mainstream of central Thai culture.

This research has attempted to formulate an overall sequence for one small area in Northeast Thailand. It must be remembered, however, that the results presented here are only tentative, and that the proposed sequence cannot by any means be regarded as definitive. The frustrations inherent in working with such an inadequate amount of data will be obvious to anyone who has attempted a similar study. Trends which appear to be significant can never be regarded as althogether conclusive, and one is continually confronted with the necessity of making allowances for the limitations of one's data. Moreover,

it is practically impossible for the researcher working under such conditions to achieve any great understanding of the human population responsible for the artifacts he is studying - and this must surely be his ultimate concern as an anthropologist.

It is to be hoped, therefore, that in the future, further research will be possible to allow the four Phu Wiang sites, along with others in the vicinity to be excavated more completely, so that not only may more validity be afforded the sequence postulated here, but also that a more precise insight may be gained into the nature of the people who inhabited the sites. Since all four of the sites were apparently marginal to any occupational zones, the isolation and excavation of sites in the area providing more conclusive evidence of habitation, would be particularly valuable in this respect. Of special significance is the fact that the sites span the time of the introduction of iron into the area, and may well yield valuable information on early iron-manufacturing techniques, as well as providing a clearer picture of other cultural changes associated with the introduction of this item only hinted at here (for example the possible introduction of wet rice).

In conclusion, the Phu Wiang area holds considerable potential for future prehistoric research. The majority of the Nam Phong and Ban Pho sites, for example have not yet been excavated. Should this be possible in the future, their contribution to Southeast Asian prehistory should be considerable.

FIG. 3 PERCENTAGE DISTRIBUTIONS OF MAJOR TEMPER TYPES

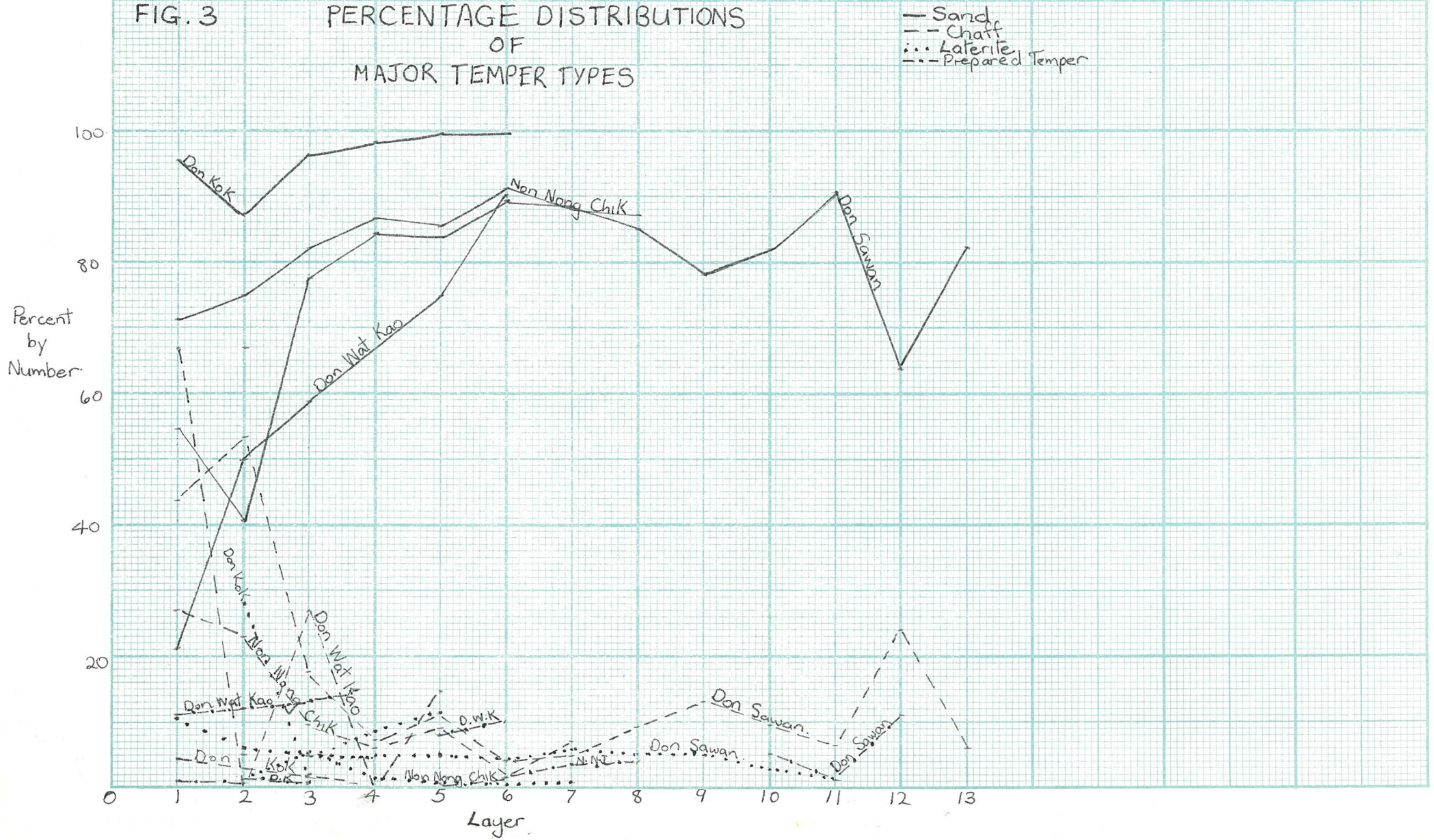
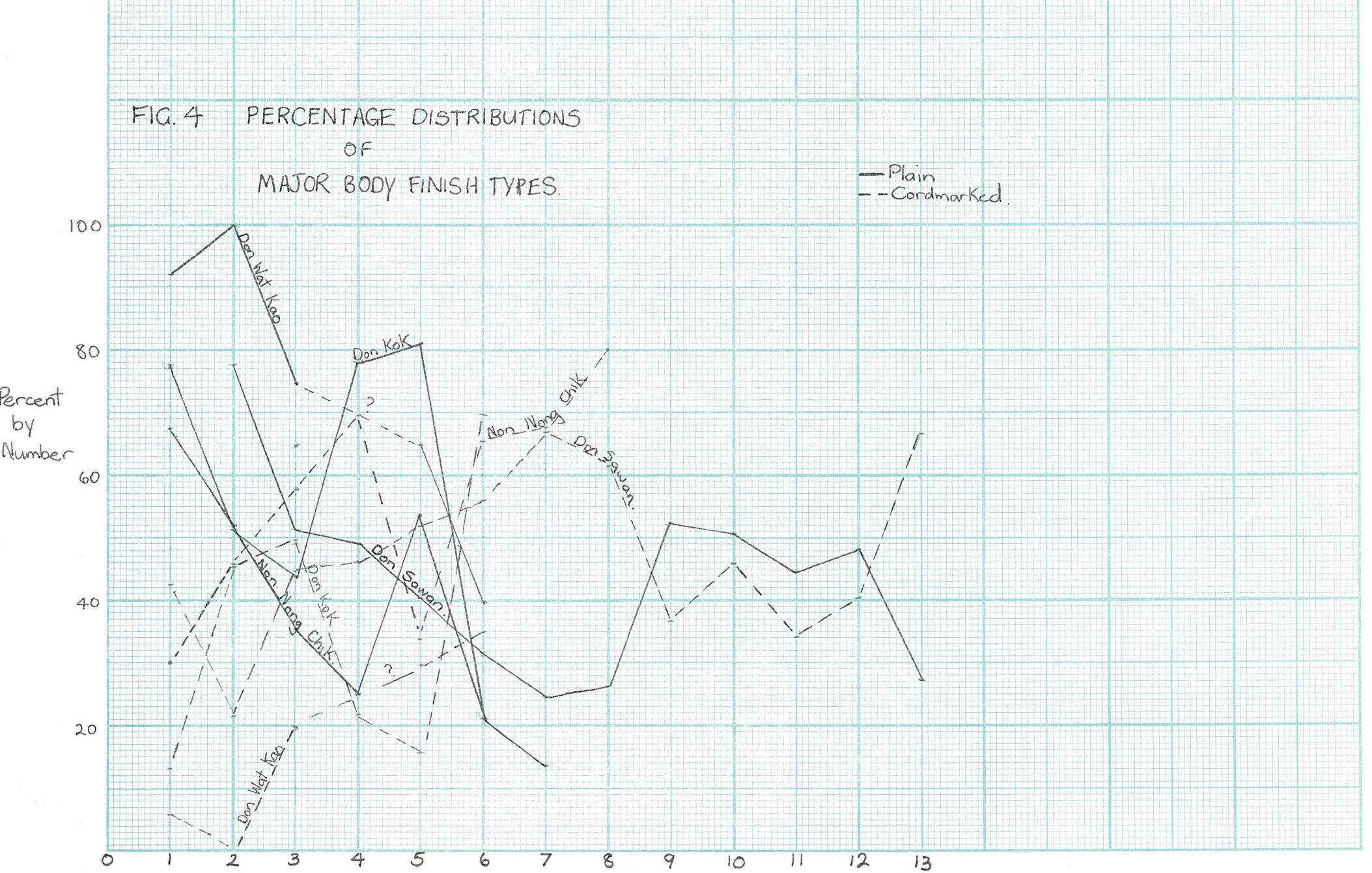


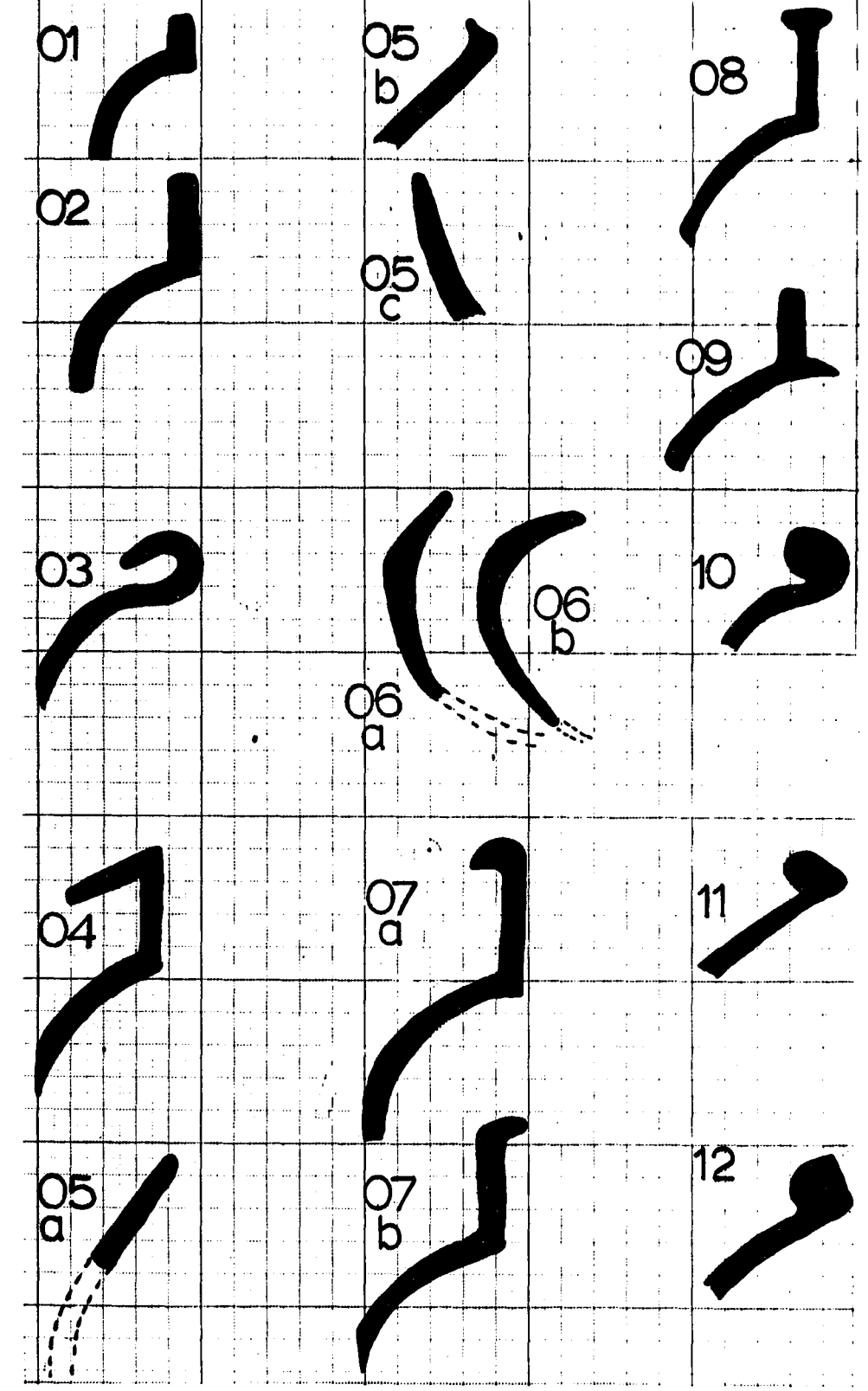
FIG. 4 PERCENTAGE DISTRIBUTIONS OF MAJOR BODY FINISH TYPES.



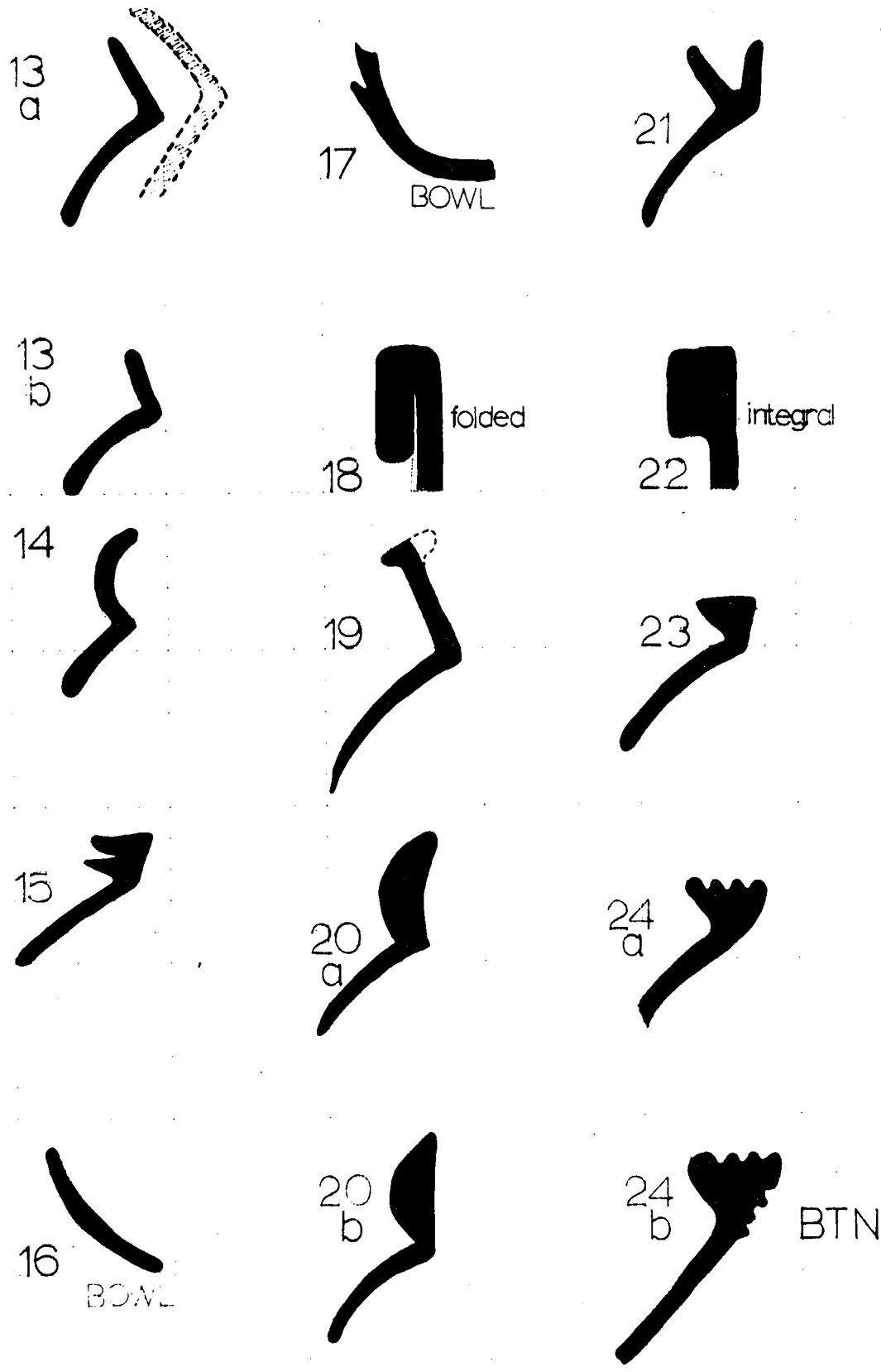
APPENDIX I :

Rim Forms

RIM FORMS columns 26~38

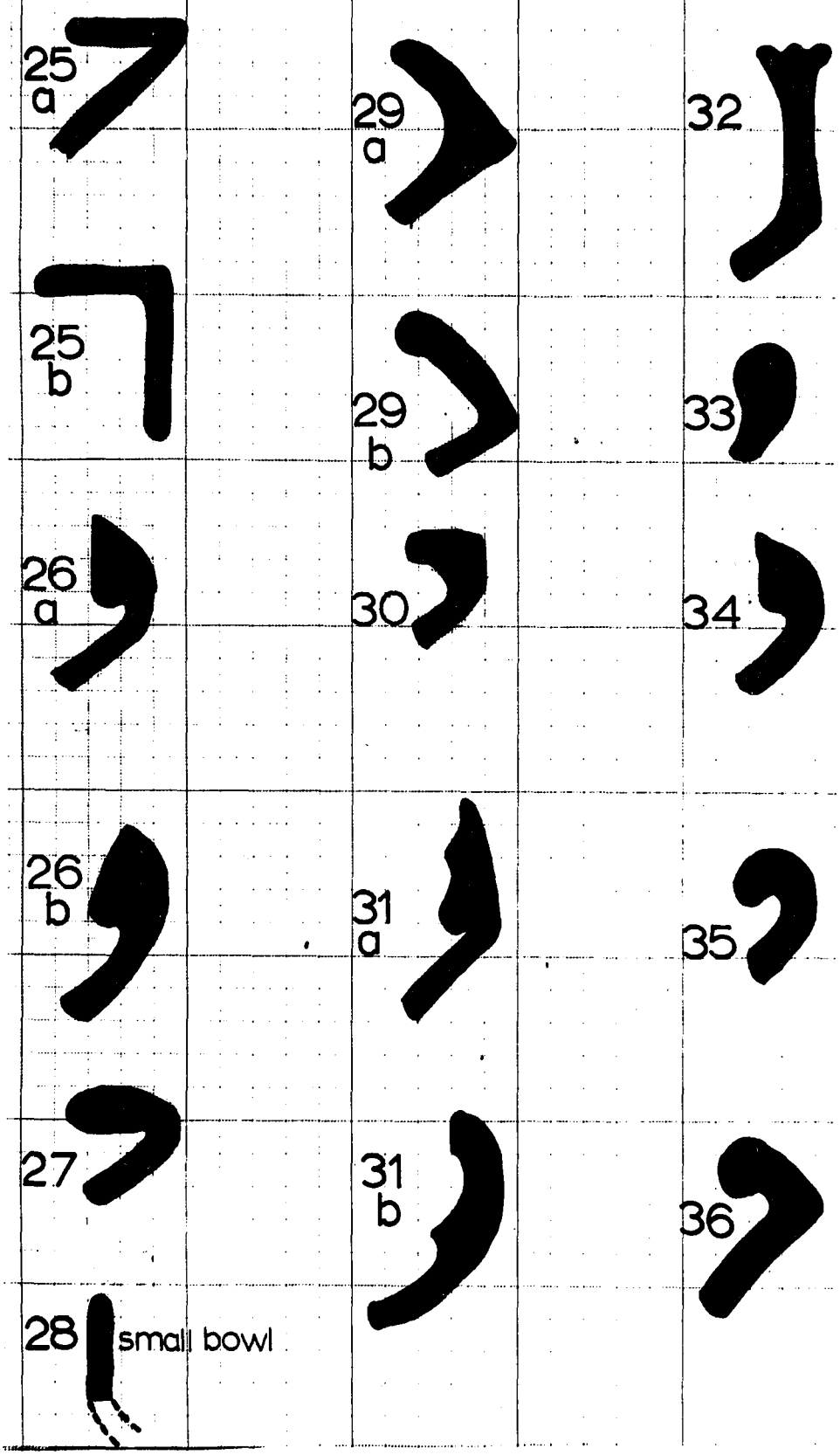


IN ALL RIM FORMS THE R.H.
SIDE OF THE DIAGRAM REPRESENTS
THE INTERIOR OF THE POT.

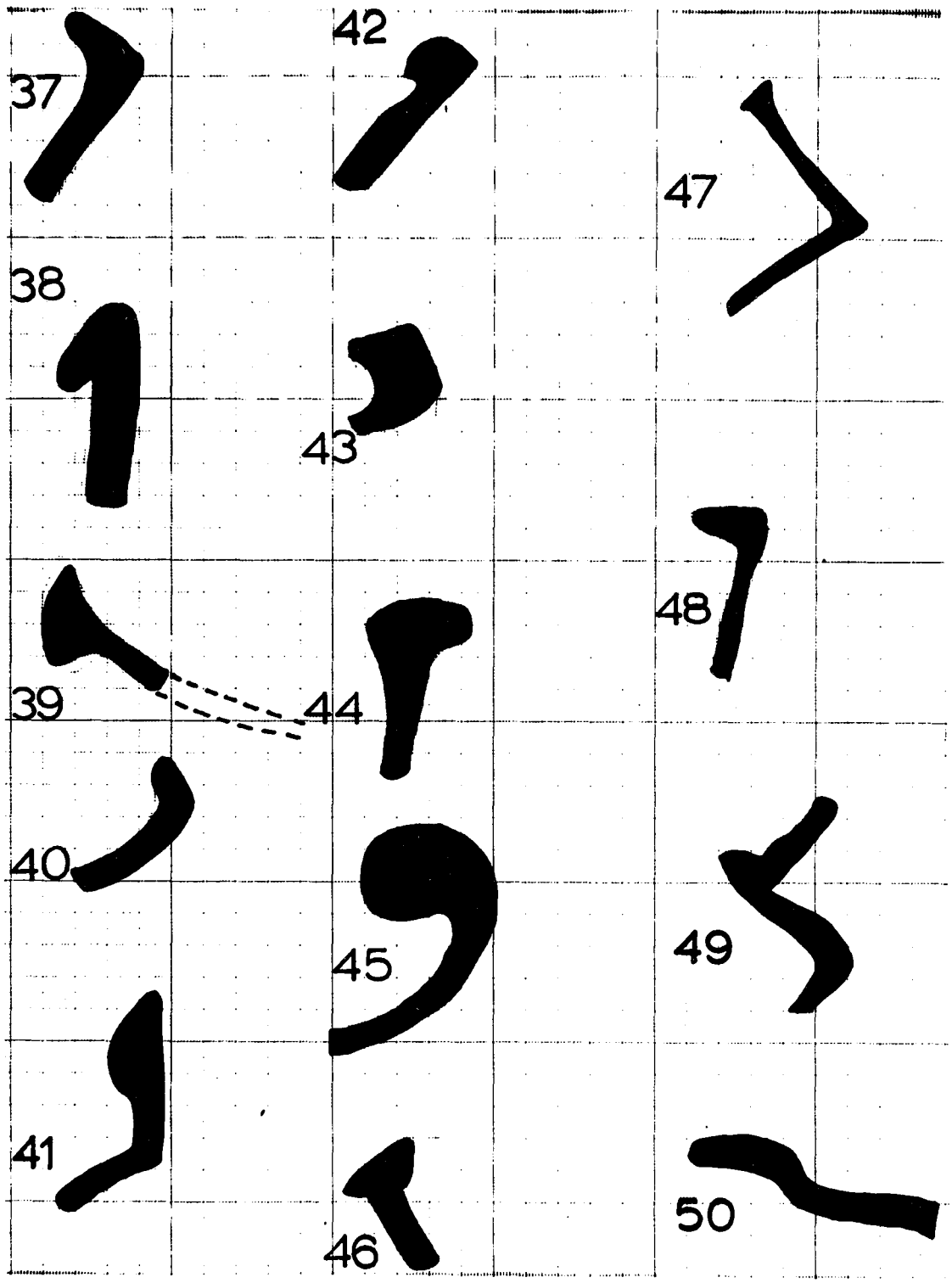


IN ALL RIM FORMS THE R H
SIDE OF THE DIAGRAM REPRESENTS
THE INTERIOR OF THE POT

RIM FORMS columns - 26 - 38

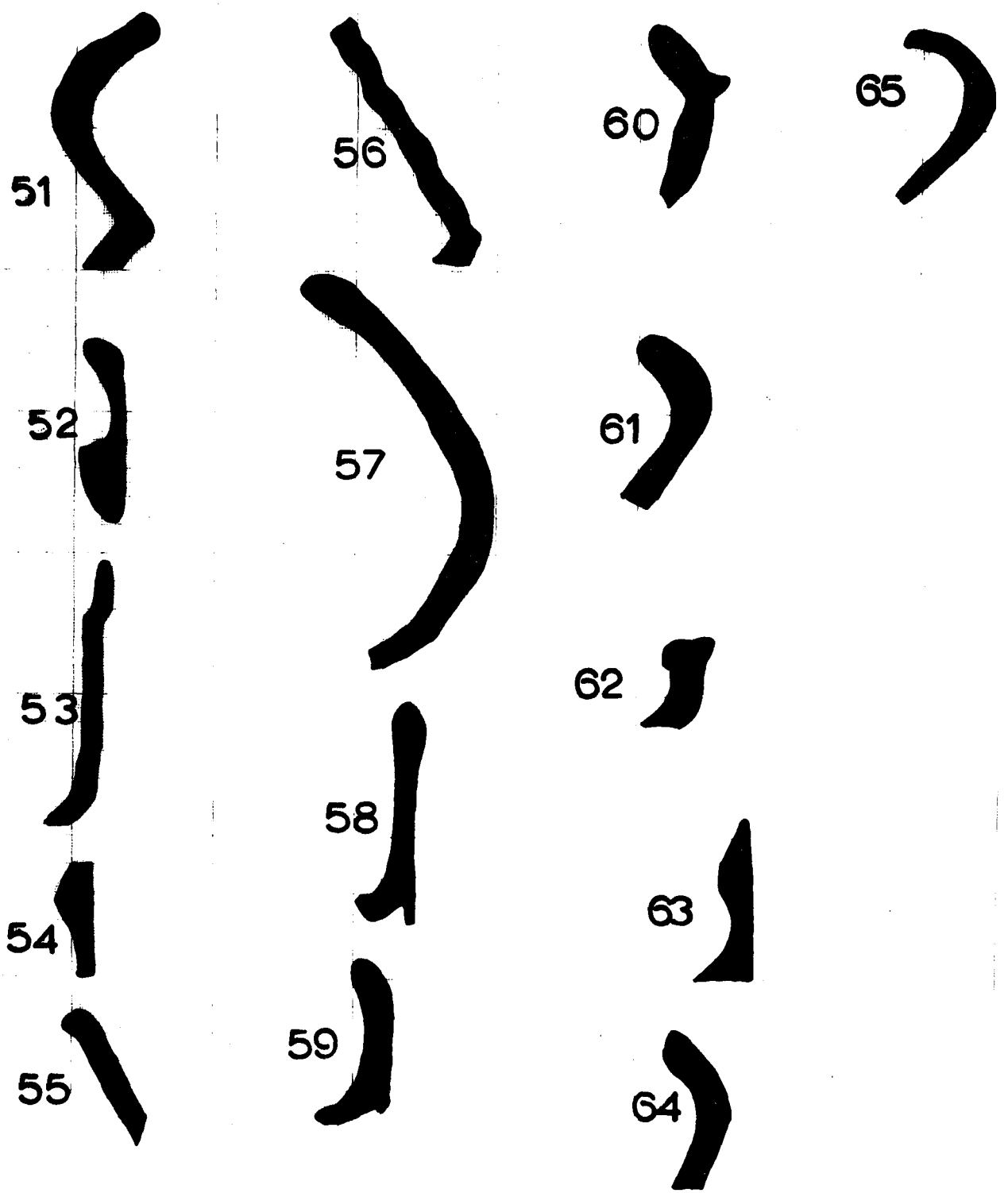


IN ALL RIM FORMS THE R.H. SIDE OF THE DIAGRAM REPRESENTS THE INTERIOR OF THE POT.



IN ALL RIM FORMS THE R.H.
SIDE OF THE DIAGRAM REPRESENTS
THE INTERIOR OF THE POT.

RIM FORMS - columns 26 - 38



IN ALL RIM FORMS THE R.H
SIDE OF THE DIAGRAM REPRESENTS
THE INTERIOR OF THE POT

APPENDIX II :

Tables

TABLE I

EARTHENWARE TEMPER ANALYSIS

Non Nong Chik

Layer	Temper Type	Total by number	Percentage by number	Total by weight	Percentage by weight
1	Soft sand	116	71.2	165	64.5
	Chaff	27	16.6	61	23.8
	Chaff and sand	18	11.0	25	9.8
	Prepared clay	2	1.2	5	2.0
2	Hard sand	419	73.5	2242	66.4
	Soft sand	10	1.8	39	1.3
	Hard chaff	125	21.9	1019	30.2
	Crushed chaff	6	1.1	19	.6
	Laterite	6	1.1	28	.9
	Prepared clay	3	.5	12	.5
3	Hard sand	1328	78.3	4964	60.7
	Soft sand	70	4.1	472	5.8
	Large sand grains	5	.3	22	.3
	Sand and chaff	4	.2	25	.3
	Sand, chaff, prepared clay	1	.1	9	.1
	Sand and gravel	1	.1	15	.2
	Sand and prepared clay	2	.1	17	.2
	Soft chaff	13	.8	30	.4
	Hard chaff	139	8.2	849	10.4
	Chaff and some fine sand	1	.1	1	.0
	Crushed chaff	10	.6	78	1.0
	Laterite	54	3.2	1032	12.6
	Laterite and sand	36	2.1	416	5.1
	Prepared clay	26	1.5	127	1.6
	Clay and chaff	5	.3	122	1.5
4	Hard sand	894	75.4	10065	73.1
	Soft sand	96	8.1	726	5.3
	Sand and chaff	11	.9	105	.8
	Fine white sand	3	.3	11	.1
	Sand and red pigment	5	.4	270	2.0
	Sand and small laterite lumps	16	1.4	106	.8
	Sand and large laterite lumps	1	.1	9	.1
	Chaff	1	.1	1	.0
	Soft chaff	19	1.6	31	.2
	Hard chaff	33	2.8	134	1.0

TABLE I - continued

Layer	Temper Type	Total by number	Percentage by number	Total by weight	Percentage by weight
	Chaff and sand	7	.6	24	.2
	Crushed chaff	11	.9	44	.3
	Chaff and small amount of clay	3	.3	5	.0
	Laterite	16	1.4	1634	11.9
	Laterite and clay	1	.1	3	.0
	Prepared clay	51	4.3	546	4.0
	Clay and some sand	3	.3	15	.1
	Prepared temper	2	.2	7	.1
	Clay and chaff	3	.3	9	.1
	Clay and rock	9	.8	18	.1
5	Hard sand	336	41.1	1210	46.8
	Soft sand	338	41.3	797	32.8
	Sand and chaff	16	2.0	42	1.7
	Sand, chaff, iron slag, and clay	4	.5	3	.1
	Sand and clay	3	.4	17	.7
	Sand and rock	1	.1	3	.1
	Soft chaff	42	5.1	108	4.4
	Hard chaff	22	2.7	68	2.8
	Crushed chaff	6	.7	20	.8
	Chaff and clay	5	.6	17	.7
	Laterite	2	.2	8	.3
	Laterite and clay	4	.5	5	.2
	Prepared clay	8	1.0	46	1.9
	Clay and some sand	6	.7	20	.8
	Prepared temper	2	.2	8	.3
	Clay and rock	23	2.8	60	2.5
6	Hard sand	800	87.2	2519	82.8
	Soft sand	30	3.3	115	3.8
	Slight amount of sand	3	.3	21	.7
	Sand and chaff	3	.3	11	.4
	Sand, chaff and prepared temper	1	.1	9	.3
	Sand and small laterite lumps	3	.3	23	.8
	Sand and rock	1	.1	12	.4
	Soft chaff	11	1.2	36	1.2
	Hard chaff	8	.9	79	2.6
	Crushed chaff	10	1.1	41	1.3
	Chaff and small amount of clay	2	.2	8	.3
	Chaff and clay	7	.8	3	.1
	Laterite and sand	1	.1	9	.3

TABLE I - continued

Layer	Temper Type	Total by number	Percentage by number	Total by weight	Percentage by weight
	Prepared clay	28	3.1	92	3.0
	Clay and some sand	6	.7	33	1.1
	Clay, sand and laterite	1	.1	11	.4
	Clay and rock	1	.1	17	.6
7	Hard sand	82	55.4	309	37.4
	Soft sand	21	14.2	115	13.9
	Sand and chaff	12	8.1	66	8.0
	Sand, chaff and laterite	2	1.4	40	4.8
	Sand and clay	10	6.8	179	21.6
	Sand, clay and laterite	1	.7	3	.4
	Sand and large laterite lumps	2	1.4	8	1.0
	Soft chaff	1	.7	1	.1
	Chaff and sand	3	2.0	33	4.0
	Crushed chaff	5	3.4	18	2.2
	Chaff and clay	2	1.4	9	1.1
	Laterite	1	.7	3	.4
	Prepared clay	4	2.7	34	4.1
	Clay and some sand	1	.7	3	.4
	Clay and chaff	1	.7	6	.7
8	Soft sand	1	12.5	6	13.3
	Sand and chaff	6	75.0	34	75.6
	Prepared clay	1	12.5	5	11.1
Don Sawan					
1	Hard sand	25	54.3	96	46.2
	Chaff	2	4.3	22	10.6
	Hard chaff	14	30.4	45	21.6
	Laterite	5	10.9	45	21.6
2	Hard sand	65	40.9	270	32.5
	Hard chaff	85	53.5	484	58.3
	Laterite	9	5.7	76	9.2
3	Hard sand	111	75.5	528	61.9
	Large sand grains	3	2.0	27	3.2
	Chaff	3	2.0	22	2.6
	Hard chaff	23	15.6	127	14.9
	Laterite	7	4.8	149	17.5

TABLE I - continued

Layer	Temper Type	Total by number	Percentage by number	Total by weight	Percentage by weight
4	Hard sand	343	84.3	2180	68.5
	Hard chaff	30	7.4	235	7.4
	Laterite	34	8.4	767	24.1
5	Hard sand	320	83.8	1979	84.0
	Hard chaff	44	11.5	156	6.6
	Laterite	18	4.7	220	9.3
6	Hard sand	393	89.7	2229	79.4
	Hard chaff	18	4.1	154	5.5
	Sand and small laterite lumps	2	.5	113	4.0
	Laterite	25	5.7	312	11.1
7	Hard sand	382	88.2	2034	78.7
	Sand and small laterite lumps	4	.9	44	1.7
	Hard chaff	22	5.1	145	5.6
	Laterite	25	5.8	362	14.0
8	Hard sand	107	84.2	634	86.9
	Sand and small laterite lumps	2	1.6	19	2.6
	Hard chaff	12	9.5	44	6.0
	Laterite	6	4.7	32	4.3
9	Hard sand	40	78.4	173	78.6
	Hard chaff	4	7.8	26	11.8
	Crushed chaff	3	5.9	9	4.1
	Laterite	3	5.9	10	4.5
	Prepared clay	1	2.0	2	.9
10	Hard sand	88	79.3	310	78.5
	Sand and chaff	3	2.7	17	4.3
	Crushed chaff	11	9.9	38	9.6
	Laterite	3	2.7	10	2.5
	Prepared clay	6	5.4	20	5.1
11	Hard sand	68	89.5	202	87.8
	Soft sand	1	1.3	3	1.3
	Hard chaff	3	3.9	8	3.5
	Crushed chaff	2	2.6	6	2.6
	Laterite and clay	1	1.3	5	2.2
	Prepared clay	1	1.3	6	2.6
12	Hard sand	35	64.8	146	63.8
	Crushed chaff	13	24.1	58	25.3
	Prepared clay	6	11.1	25	10.9
13	Hard sand	46	90.2	211	90.9
	Sand and gravel	1	2.0	2	.9
	Hard chaff	3	5.9	8	3.4
	Prepared clay	1	2.0	11	4.7

TABLE I - continued

Don Wat Kao

Layer	Temper Type	Total by number	Percentage by number	Total by weight	Percentage by weight
1	Hard sand	1	3.7	1	1.0
	Soft sand	5	18.5	12	11.5
	Hard chaff	18	66.7	76	73.1
	Prepared clay	3	11.1	15	14.4
2	Hard sand	4	50.0	12	37.5
	Chaff and laterite	1	12.5	13	40.6
	Prepared clay	1	12.5	3	9.4
	Clay and some sand	1	12.5	2	6.3
	Prepared temper	1	12.5	2	6.3
3	Hard sand	3	6.8	9	6.9
	Soft sand	23	52.3	78	60.0
	Hard chaff	12	27.3	32	24.6
	Prepared clay	6	13.6	11	8.5
5	Hard sand	22	23.4	75	20.7
	Soft sand	46	48.9	153	42.1
	Sand and gravel	3	3.2	3	.8
	Hard chaff	14	14.9	92	25.3
	Laterite and sand	1	1.1	3	.8
	Prepared clay	8	8.5	37	10.2
6	Hard sand	12	60.0	17	41.5
	Soft sand	6	30.0	17	41.5
	Prepared clay	2	10.0	7	17.1

Don Kok

1	Hard sand	17	77.3	57	67.9
	Soft sand	4	18.2	14	16.7
	Chaff and laterite	1	4.5	13	15.5
2	Hard sand	28	46.7	59	18.2
	Soft sand	12	20.0	28	8.6
	Laterite	17	28.3	209	64.3
	Prepared clay	3	5.0	29	8.9
3	Hard sand	249	34.1	1249	37.9
	Soft sand	441	60.4	1852	56.2
	Sand and chaff	2	.3	5	.2
	Sand and small laterite lumps	3	.4	25	.8
	Hard chaff	2	.3	8	.2
	Chaff and sand	8	1.1	40	1.2

TABLE I - continued

Layer	Temper Type	Total by number	Percentage by number	Total by weight	Percentage by weight
	Chaff and small amount of clay	1	.1	2	.1
	Laterite	1	.1	3	.1
	Prepared clay	14	1.9	54	1.6
	Clay and some sand	2	.3	21	.6
	Prepared temper	3	.4	7	.2
	Clay and chaff	3	.4	26	.8
4	Hard sand	9	14.5	31	23.7
	Soft sand	8	12.9	38	29.0
	Sand and small laterite lumps	44	71.0	59	45.0
	Laterite and clay	1	1.6	3	2.3
5	Hard sand	113	20.8	537	16.7
	Soft sand	14	2.6	30	.9
	Sand and small laterite lumps	412	76.0	2647	82.2
	Prepared clay	3	.6	6	.2
6	Hard sand	13	6.5	52	6.2
	Soft sand	15	7.5	47	5.6
	Sand and small laterite lumps	31	15.5	133	15.8
	Sand and large laterite lumps	139	69.5	599	71.1
	Prepared clay	2	1.0	12	1.4

TABLE II

NON-EARTHENWARE TEMPER ANALYSIS

Stoneware

Don Sawan

Layer	Temper Type	Total by number	Percentage by number	Total by weight	Percentage by weight
2	Little temper, unglazed	2	33.3	23	33.3
	Little temper, brown glaze	1	16.7	43	4.3
	Moderate sand	3	50	43	62.3

Semi-vitreous Proto-porcelain

Don Sawan

1	Partly glazed, pale green glaze	1	100	7	100
2	Partly glazed, pale green glaze	1	100	12	100
3	Partly glazed, pale green glaze	1	100	79	100
4	Partly glazed, pale green glaze, transparent	3	100	4	100

True Porcelain

Don Sawan

1	Partly glazed, colourless glaze	1	100	9	100
2	Partly glazed, transparent glaze	1	100	2	100

TABLE III

RIM FORM ANALYSIS

Non Nong Chik

Layer	Rim Type	Total by number	Percentage by number	Total by weight	Percentage by weight
2	05	4	6.6	73	11.9
	07	3	4.9	141	22.9
	58	1	1.6	24	3.9
	59	1	1.6	41	6.7
	99	52	85.2	336	54.6
3	05	2	2.2	37	4.8
	06	1	1.1	44	5.7
	07	1	1.1	42	5.4
	16	6	6.7	142	18.3
	99	79	88.8	510	65.8
4	01	2	5.3	8	3.5
	02	1	2.6	8	3.5
	05	4	10.5	29	12.6
	99	31	81.6	186	80.5
5	01	1	3.7	4	2.3
	05	8	29.6	53	31.0
	10	1	3.7	10	5.8
	14	1	3.7	3	1.8
	19	1	3.7	3	1.8
	37	2	7.4	23	13.5
	39	1	3.7	32	18.7
	40	1	3.7	3	1.8
	99	11	40.7	40	23.4
6	05	28	87.5	91	58.7
	14	2	6.3	33	21.3
	40	1	3.1	26	16.8
	49	1	3.1	5	3.2
7	02	7	63.6	234	83.6
	05	3	27.3	40	14.3
	10	1	9.1	6	2.1
8	05	2	66.7	12	63.2
	13	1	33.3	7	36.8

Don Sawan

1	05	1	16.7	7	17.9
	99	5	83.3	32	82.1
2	01	2	9.5	10	4.4
	33	2	9.5	63	27.9
	99	17	81.0	153	67.7
3	99	26	100	263	100

TABLE III - continued

Layer	Rim Type	Total by number	Percentage by number	Total by weight	Percentage by weight
4	05	1	1.8	230	22.2
	07	2	3.6	81	7.8
	10	1	1.8	72	6.9
	35	1	1.8	70	6.7
	99	51	91.1	583	56.4
5	65	1	1.9	55	10.5
	99	52	98.1	470	89.5
6	02	1	1.3	76	7.4
	07	2	2.6	58	5.7
	33	1	1.3	28	2.7
	64	1	1.3	103	10.1
	99	73	93.6	758	74.1
7	05	2	3.2	46	7.9
	26	1	1.6	47	8.1
	99	59	95.2	488	84.0
8	37	1	6.7	5	4.5
	99	14	93.3	106	95.5
9	99	5	100	43	100
10	59	1	25.0	20	43.5
	60	1	25.0	6	13.0
	99	2	50.0	20	43.5
11	99	8	100	27	100
13	99	3	100	29	100
Don Wat Kao					
1	99	1	100	9	100
3	99	4	100	16	100
5	05	1	14.3	13	18.3
	06	1	14.3	12	16.9
	58	1	14.3	10	14.1
	99	4	57.1	36	50.7
Don Kok					
2	99	1	100	3	100
3	06	1	2.7	34	8.3

TABLE III - continued

Layer	Rim Type	Total by number	Percentage by number	Total by weight	Percentage by weight
	33	1	2.7	13	3.2
	37	1	2.7	27	6.6
	99	34	91.9	334	81.9
4	99	6	100	35	100
6	02	1	14.3	20	43.5
	37	1	14.3	3	6.5
	41	1	14.3	9	19.6
	99	4	57.1	14	30.4
Mixed Sherds					
Non Nong Chik					
2	06	1	50.0	53	94.6
	49	1	50.0	3	5.4
3	16	1	4.5	91	17.8
	58	7	31.8	152	29.7
	59	6	27.3	96	18.8
	61	5	22.7	122	23.9
	99	3	13.6	50	9.8
4	37	1	6.3	52	6.9
	38	1	6.3	18	2.4
	39	5	31.3	270	36.0
	41	6	37.5	396	52.8
	42	1	6.3	7	.9
	99	2	12.5	7	.9
5	07	2	100	14	100
6	05	3	37.5	26	12.7
	07	5	62.5	179	87.3
7	02	1	100	19	100
Don Sawan					
4	99	1	100	17	100
5	99	2	100	16	100
7	05	1	100	22	100
8	13	2	66.7	75	68.2
	63	1	33.3	35	31.8

TABLE III - continued

Don Kok

Layer	Rim Type	Total by number	Percentage by number	Total by weight	Percentage by weight
3	05	1	25.0	16	32.0
	07	1	25.0	15	30.0
	13	2	50.0	19	38.0
4	03	1	100	2	100
5	13	1	100	13	100
6	37	1	100	4	100

TABLE IV

OUTER RIM FINISH - GENERAL

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
2	Plain	60	98.4	605	98.4
	Red slip	1	1.6	10	1.6
3	Blank	1	1.1	25	3.2
	Plain	87	97.8	741	95.6
	Red slip	1	1.1	9	1.2
4	Plain	36	94.7	217	93.9
	Polished	1	2.6	11	4.8
	Red slip and polished	1	2.6	3	1.3
5	Plain	23	85.2	154	90.1
	Blank	1	3.7	4	2.3
	Polished	2	7.4	10	5.8
	Red slip and polished	1	3.7	3	1.8
6	Plain	32	100	155	100
7	Plain	10	90.9	246	87.9
	Red slip	1	9.1	34	12.1
8	Plain	3	100	19	100

Don Sawan

1	Plain	6	100	39	100
2	Plain	21	100	226	100
3	Plain	26	100	263	100
4	Plain	56	100	1038	100
5	Plain	53	100	525	100
6	Plain	79	100	1054	100
7	Plain	57	91.9	528	90.9
	Red slip	4	6.5	44	7.6
	Dark Paint	1	1.6	9	1.5
8	Plain	12	80.0	98	88.3
	Red slip	2	13.3	9	8.1
	Polished	1	6.7	4	3.6

TABLE IV - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
9	Plain	3	60.0	30	69.8
	Polished	2	40.0	13	30.2
10	Plain	4	100	46	100
11	Plain	8	100	27	100
13	Plain	3	100	29	100
Don Wat Kao					
1	Plain	1	100	9	100
3	Plain	4	100	16	100
5	Plain	6	85.7	59	83.1
	Red slip	1	.4.3	12	16.9
Don Kok					
2	Plain	1	100	3	100
3	Plain	37	100	408	100
4	Plain	3	50.0	7	20.0
	Red slip	1	16.7	3	8.6
	Polished	2	33.3	25	71.4
6	Plain	5	71.4	17	37.0
	Polished	2	28.6	29	63.0
Mixed Sherds					
Non Nong Chik					
2	Plain	2	100	56	100
3	Plain	22	100	511	100
4	Plain	12	75.0	531	70.8
	Polished	4	25.0	219	29.2
5	Plain	2	100	14	100
6	Blank	1	12.5	4	2.0
	Plain	7	87.5	201	98.0

TABLE IV - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
7	Plain	1	100	19	100
Don Sawan					
4	Plain	1	100	17	100
5	Plain	2	100	16	100
7	Plain	1	100	22	100
8	Plain	3	100	110	100
Don Kok					
3	Plain	4	100	50	100
4	Plain	1	100	2	100
5	Plain	1	100	13	100
6	Plain	1	100	4	100

TABLE V

OUTER RIM FINISH - INCISION OR IMPRESSION

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
2	Not incised or impressed	61	100	615	100
3	Incised, freehand straight lines	1	1.1	25	3.2
	Not incised or impressed	88	98.9	750	96.8
4	Not incised or impressed	38	100	231	100
5	Not incised or impressed	25	92.6	159	93.0
	Incised, freehand straight lines	1	3.7	4	2.3
	Cordmarked	1	3.7	8	4.7
6	Not incised or impressed	30	93.8	122	78.7
	Incised, freehand simple decoration	1	6.3	13	21.3
7	Not incised or impressed	8	72.7	235	83.9
	Incised, freehand simple decoration	1	9.1	6	2.1
	Cordmarked	1	9.1	34	12.1
	Stamp or carved paddle	1	9.1	5	1.8
8	Not incised or impressed	3	100	19	100

Don Sawan

1	Not incised or impressed	6	100	39	100
2	Not incised or impressed	21	100	226	100
3	Not incised or impressed	26	100	263	100
4	Not incised or impressed	56	100	1038	100
5	Not incised or impressed	53	100	525	100
6	Not incised or impressed	79	100	1054	100

TABLE V - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
7	Not incised or impressed	62	100	581	100
8	Not incised or impressed	15	100	111	100
9	Not incised or impressed	5	100	43	100
10	Not incised or impressed	4	100	46	100
11	Not incised or impressed	8	100	27	100
13	Not incised or impressed	3	100	29	100
Don Wat Kao					
1	Not incised or impressed	1	100	9	100
3	Not incised or impressed	4	100	16	100
5	Not incised or impressed	7	100	71	100
Don Kok					
2	Not incised or impressed	1	100	3	100
3	Not incised or impressed	37	100	408	100
4	Not incised or impressed	6	100	35	100
6	Not incised or impressed	7	100	46	100

TABLE V - continued

Mixed Sherds

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
2	Not incised or impressed	2	100	56	100
3	Not incised or impressed	22	100	511	100
4	Not incised or impressed	16	100	750	100
5	Not incised or impressed	2	100	14	100
6	Not incised or impressed	7	87.5	201	98.0
	Cordmarked	1	12.5	4	2.0
7	Not incised or impressed	1	100	19	100

Don Sawan

4	Not incised or impressed	1	100	17	100
5	Not incised or impressed	2	100	16	100
7	Not incised or impressed	1	100	22	100
8	Not incised or impressed	3	100	110	100

Don Kok

3	Not incised or impressed	4	100	50	100
4	Not incised or impressed	1	100	2	100
5	Not incised or impressed	1	100	13	100
6	Not incised or impressed	1	100	4	100

TABLE VI

INNER RIM FINISH - GENERAL

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
2	Plain	60	98.4	605	98.4
	Red slip	1	1.6	10	1.6
3	Plain	88	98.9	766	98.9
	Red slip	1	1.1	9	1.2
4	Plain	38	100	231	100
5	Plain	25	92.6	163	95.3
	Polished	1	3.7	5	2.9
	Red slip and polished	1	3.7	3	1.8
6	Plain	32	100	155	100
7	Plain	10	90.9	246	87.9
	Red slip and polished	1	9.1	34	12.1
8	Plain	3	100	19	100

Don Sawan

1	Plain	6	100	39	100
2	Plain	21	100	226	100
3	Plain	26	100	263	100
4	Plain	56	100	1038	100
5	Plain	53	100	525	100
6	Plain	79	100	1054	100
7	Plain	56	90.3	531	89.7
	Red slip	6	9.7	60	10.3
8	Plain	13	86.7	102	91.9
	Polished	2	13.3	9	8.1
9	Plain	3	60.0	30	69.8
	Polished	2	40.0	13	30.2

TABLE VI - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
10	Plain	4	100	46	100
11	Plain	8	100	27	100
13	Plain	3	100	29	100
Don Wat Kao					
1	Plain	1	100	9	100
3	Plain	4	100	16	100
5	Plain	7	100	71	100
Don Kok					
2	Plain	1	100	3	100
3	Plain	37	100	408	100
4	Plain	5	83.3	32	91.4
	Red slip	1	16.7	3	8.6
6	Plain	6	85.7	43	93.5
	Polished	1	14.3	3	6.5
Mixed Sherds					
Non Nong Chik					
2	Plain	2	100	56	100
3	Plain	22	100	511	100
4	Plain	11	68.8	480	64.0
	Polished	5	31.3	270	36.0
5	Plain	2	100	14	100
6	Plain	8	100	205	100
7	Plain	1	100	19	100

TABLE VI - continued

Don Sawan

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
4	Plain	1	100	17	100
5	Plain	2	100	16	100
7	Plain	1	100	22	100
8	Plain	3	100	110	100
Don Kok					
3	Plain	4	100	50	100
4	Plain	1	100	2	100
5	Plain	1	100	13	100
6	Plain	1	100	4	100

TABLE VII

INNER RIM FINISH - INCISION OR IMPRESSION

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
2	Not incised or impressed	61	100	615	100
3	Not incised or impressed	88	98.9	750	96.8
	Incised freehand straight lines	1	1.1	25	3.2
4	Not incised or impressed	38	100	231	100
5	Not incised or impressed	27	100	171	100
6	Not incised or impressed	32	100	155	100
7	Not incised or impressed	11	100	280	100
8	Not incised or impressed	2	66.7	12	63.2
	Impressed with a simple tool	1	33.3	7	36.8

Don Sawan

1	Not incised or impressed	6	100	39	100
2	Not incised or impressed	21	100	226	100
3	Not incised or impressed	25	96.2	184	70.0
	Incised freehand straight lines	1	3.8	79	30.0
4	Not incised or impressed	56	100	1038	100
5	Not incised or impressed	53	100	525	100
6	Not incised or impressed	79	100	1054	100

TABLE VII - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
7	Not incised or impressed	62	100	581	100
8	Not incised or impressed	15	100	111	100
9	Not incised or impressed	5	100	43	100
10	Not incised or impressed	4	100	46	100
11	Not incised or impressed	8	100	27	100
13	Not incised or impressed	3	100	29	100
Don Wat Kao					
1	Not incised or impressed	1	100	9	100
3	Not incised or impressed	4	100	16	100
5	Not incised or impressed	7	100	71	100
Don Kok					
2	Not incised or impressed	1	100	3	100
3	Not incised or impressed	37	100	408	100
4	Not incised or impressed	6	100	35	100
6	Not incised or impressed	7	100	46	100

TABLE VII - continued

Mixed Sherds

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
2	Not incised or impressed	2	100	56	100
3	Not incised or impressed	22	100	511	100
4	Not incised or impressed	16	100	750	100
5	Not incised or impressed	2	100	14	100
6	Not incised or impressed	8	100	205	100
7	Not incised or impressed	1	100	19	100
Don Sawan					
4	Not incised or impressed	1	100	17	100
5	Not incised or impressed	2	100	16	100
7	Not incised or impressed	1	100	22	100
8	Not incised or impressed	3	100	110	100
Don Kok					
3	Not incised or impressed	4	100	50	100
4	Not incised or impressed	1	100	2	100
5	Not incised or impressed	1	100	13	100
6	Not incised or impressed	1	100	4	100

TABLE VIII

SHOULDER FINISH - GENERAL

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
3	01-plain	1	100	9	100
4	01	2	40.0	13	39.3
	22-diagonal c/m	1	20.0	5	15.1
	23-horizon. c/m	1	20.0	7	21.2
	99-indeterminate	1	20.0	8	24.4
5	43-dk slip on 01 sm/cm	1	14.2	5	6.1
		6	85.7	77	93.9
6	01	1	100	5	100
7	01	1	100	14	100

Don Sawan

1	01	3	100	17	100
3	26-cross-htch c/m, angle close to 90°	2	100	62	100
4	01	3	42.8	24	28.6
	21- vert. c/m	1	14.3	20	23.8
	20-unspec. unidirectional c/m	3	42.8	40	47.6
5	01	2	33.3	36	39.1
	21	2	33.3	17	18.5
	22	1	16.7	30	32.6
	25-cross-htch c/m, angle 45-80°	1	16.7	9	9.8
7	01	1	100	18	100

Mixed Sherds

Non Nong Chik

2	01	10	100	107	100
3	01	21	95.5	180	92.3
	99	1	4.5	15	7.7
4	01	17	68.0	1020	71.7
	25	7	28.0	403	28.1
	99	1	4	12	.8
5	01	2	66.7	11	61.1
	40-undifferentiated sm/cm	1	33.3	7	38.9

TABLE VIII - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
6	01	4	23.5	25	9.5
	22	5	29.4	179	68.3
	25	1	5.9	16	6.1
	40	2	11.8	32	12.2
	99	5	29.4	10	3.8
7	01	3	75.0	34	64.2
	22	1	25.0	19	35.8
Don Sawan					
1	23	1	100	13	100
3	01	3	100	19	100
4	01	7	87.5	58	82.9
	40	1	12.5	12	17.1
5	01	9	100	45	100
6	01	15	71.4	107	48.2
	26	6	28.6	115	51.8
7	01	10	76.9	70	76.9
	24-cross-htch c/m, angle less than 45°	1	7.7	4	4.4
	26	1	7.7	9	9.9
	40	1	7.7	8	8.8
8	01	1	100	35	100
10	01	1	100	14	100
12	01	2	100	7	100
Don Wat Kao					
2	99	1	100	13	100
Don Kok					
3	01	4	57.1	39	67.2
	40	1	14.3	2	3.4
	99	2	28.6	17	29.3
5	01	1	100	13	100

TABLE IX

SHOULDER FINISH - INCISION OR IMPRESSION

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
4	1-incised, freehand straight lines	1	100	7	100
5	1	2	100	42	100
6	5-inc., free simple dec.	1	100	5	100

Don Sawan

1	1	3	100	17	100
3	1	2	100	62	100
4	1	5	71.4	71	84.5
	5	1	14.3	10	11.9
	6	1	14.3	3	3.6
5	1	4	100	56	100
7	4-Wavy lines, incised with comb tool	1	100	18	100

Mixed Sherds

Non Nong Chik

2	0-not incised or impressed	10	100	107	100
3	0	21	95.5	180	92.3
	1	1	4.5	15	7.7
4	0	24	96.0	1423	99.2
	1	1	4.0	12	.8
5	0	3	100	18	100
6	0	10	58.8	229	87.4
	1	1	5.9	19	7.3
	5	6	35.3	14	5.3

TABLE IX - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
7	0	2	50.0	46	86.8
	5	1	25.0	5	9.4
	9-impressed stamp or simple tool	1	25.0	2	3.8
Don Sawan					
1	0	1	100	13	100
3	0	3	100	19	100
4	0	8	100	70	100
5	0	9	100	45	100
6	0	19	90.5	203	91.4
	1	2	9.5	19	8.6
7	0	10	76.9	70	76.9
	1	3	23.1	21	23.1
8	5	1	100	35	100
10	0	1	100	14	100
12	0	2	100	7	100
Don Wat Kao					
2	5	1	100	14	100
Don Kok					
3	0	5	71.4	41	70.7
5	0	1	100	13	100

TABLE X

SHOULDER FINISH - APPLIQUE

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
3	10	1	100	9	100
4	10	1	100	8	100

Don Sawan

5	10	1	50.0	8	22.2
	03	1	50.0	28	77.8

TABLE XI

BODY FINISH ANALYSIS

Non Nong Chik

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
1	01-Plain	110	67.5	175	68.4
	05-White or buff slip	3	1.8	2	.8
	23-Horizontal cordmarking	17	10.4	28	10.9
	24-Cross-hatched cordmarking, angle less than 45°	27	16.6	39	15.2
	26-Cross-hatched cordmarking, angle close to 90°	3	1.8	6	2.3
	27-unidirectional confused cordmarking	2	1.2	2	.8
	40-undifferentiated smoothed-over cordmarking	1	.6	4	1.6
2	01	246	51.8	1223	55.3
	02-Red slip	2	.4	3	.1
	20-Unspecified Unidirectional cordmarking	95	20.0	313	14.2
	24	29	6.1	193	8.7
	25-Crosshatched cordmarking, angle 45-80°	36	7.6	89	4.0
	26	41	8.6	127	5.7
	27	17	3.6	38	10.8
	40	9	1.9	26	1.2
3	01	550	35.2	2161	32.3
	02	18	1.2	58	.9
	03-polished	6	.4	14	.2
	04-Red slip and polish	3	.2	3	.04
	13-Dark slip	3	.2	4	.1
	20	253	16.2	664	9.9
	24	81	5.2	351	5.2
	25	201	12.9	901	13.5
	26	324	20.7	2041	30.5
	27	46	2.9	255	3.8
	40	71	4.5	231	3.4
	41-Red slip over smoothed-over cordmarking	1	.1	5	.1

TABLE XI - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
	71-Simple design impressed with simple tool	4	.3	15	.2
4	01	204	25.0	634	16.8
	02	8	1.0	20	.5
	05	1	.1	2	.1
	03	2	.3	14	.4
	20	81	9.9	210	5.5
	21-Vertical cordmarking	2	.2	15	.4
	23	23	2.8	62	1.6
	24	173	21.3	870	23.0
	25	192	23.6	1202	31.8
	26	75	9.2	194	5.1
	27	22	2.7	425	11.2
	40	24	2.9	108	2.9
	41	1	.1	3	.1
	70-Impressed with simple tool, unspecified	2	.2	5	.1
	72-Complex design impressed with simple tool	2	.2	7	.2
	80-Red slip over unspecified, unidirectional cordmarking	2	.2	9	.2
5	01	420	53.9	931	43.3
	02	14	1.8	52	2.4
	03	8	1.0	37	1.7
	04	2	.3	4	.2
	05	6	.8	39	1.8
	20	42	5.4	104	4.8
	21	5	.6	7	.3
	23	13	1.7	40	1.9
	24	9	1.2	24	1.1
	25	101	13.0	382	17.8
	26	81	10.4	311	14.5
	27	11	1.4	35	1.6
	40	65	8.3	171	8.0
	42-Polished over smoothed-over cordmarking	1	.1	3	.1
	72	1	.1	7	.3
6	01	181	21.0	526	20.3
	02	4	.5	11	.4
	03	4	.5	28	1.1
	04	1	.1	17	.7
	06-White or buff slip, simple red, orange or brown design	1	.1	2	.1

TABLE XI - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
	20	187	21.7	355	13.7
	24	2	.2	7	.3
	25	116	13.4	420	16.2
	26	223	25.8	724	28.0
	27	38	4.4	151	5.8
	29	1	.1	2	.1
	40	80	9.3	242	9.3
	45-White slip over smoothed-over cordmarking	2	.2	14	.5
	70	3	.3	22	.8
	71	2	.2	6	.2
	72	18	2.1	60	2.3
7	01	18	13.8	90	19.2
	02	1	.8	2	.4
	03	1	.8	2	.4
	20	26	20.0	120	25.6
	24	1	.8	2	.4
	25	9	6.9	27	5.8
	26	47	36.2	131	27.9
	27	5	3.8	20	4.3
	40	21	16.2	69	14.7
	71	1	.8	6	1.3
8	20	1	20.0	7	26.9
	25	1	20.0	6	23.1
	26	3	60.0	13	50.0
Don	**Sawan**				
1	01	24	64.9	90	61.6
	03	1	2.7	7	4.8
	20	3	8.1	16	11.0
	25	7	18.9	14	9.6
	26	2	5.4	19	13.0
2	01	112	77.2	556	81.2
	20	24	16.6	66	9.6
	25	3	2.1	15	2.2
	26	4	2.8	42	6.1
	40	2	1.4	6	.9
3	01	61	51.2	277	47.1
	02	2	1.7	9	1.5
	20	39	33.3	234	39.8
	24	3	2.6	22	3.7
	25	3	2.6	10	1.7
	26	6	5.1	24	4.1
	27	1	.9	5	.9
	40	2	1.7	7	1.2
4	01	166	49.1	995	50.3
	02	1	.3	1	.1

TABLE XI - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
	20	104	30.8	443	22.4
	24	5	1.5	13	.7
	25	29	8.6	345	17.5
	26	10	3.0	59	3.0
	27	7	2.1	53	2.7
	40	16	4.7	68	3.4
5	01	125	40.1	718	42.8
	20	102	32.7	441	26.3
	24	15	4.8	61	3.6
	25	23	7.4	138	8.2
	26	13	4.2	111	6.6
	27	10	3.2	111	6.6
	40	23	7.4	82	4.9
	70	1	.3	15	.9
6	01	106	31.8	529	34.9
	02	4	1.2	17	1.1
	20	75	22.5	274	18.0
	24	33	9.9	193	12.7
	25	32	9.6	154	10.1
	26	40	12.0	176	11.6
	27	10	3.0	66	4.3
	40	33	9.9	106	7.0
7	01	83	23.2	574	30.3
	02	2	.6	15	.8
	03	6	1.7	51	2.7
	17-Plain, simple dark-painted design	1	.3	2	.1
	20	62	17.4	289	15.3
	24	56	15.7	326	17.2
	25	68	19.0	290	15.3
	26	37	10.4	181	9.6
	27	16	4.5	75	4.0
	40	25	7.0	89	4.7
	41	1	.3	3	.2
8	01	29	26.4	145	27.8
	02	7	6.4	27	5.2
	15-Plain, simple red, orange or brown design	1	.9	21	4.0
	20	37	33.6	119	22.8
	24	12	10.9	100	19.2
	25	10	9.1	45	8.6
	26	9	8.2	52	10.0
	40	5	4.5	13	2.5

TABLE XI -continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
9	01	24	52.2	98	55.4
	20	6	13.0	26	14.7
	24	3	6.5	21	11.9
	25	6	13.0	13	7.3
	27	2	4.3	7	4.0
	40	5	10.9	12	6.8
10	01	54	50.9	314	63.9
	20	9	8.5	14	4.2
	24	3	2.8	6	1.8
	25	11	10.4	36	10.7
	26	24	22.6	44	13.1
	27	2	1.9	9	2.7
	40	3	2.8	12	3.6
11	01	30	44.8	79	42.9
	02	1	1.5	5	2.7
	03	5	7.5	9	4.9
	20	6	9.0	9	4.9
	25	9	13.4	23	12.5
	26	8	11.9	28	15.2
	40	5	7.5	15	8.2
	70	3	4.5	16	8.7
12	01	25	48.1	87	39.2
	20	5	9.6	7	3.2
	25	8	15.4	25	11.3
	26	8	15.4	61	27.5
	40	6	11.5	42	18.9
13	01	13	27.1	61	30.0
	02	3	6.3	8	3.9
	20	6	12.5	10	4.9
	26	26	54.2	124	61.1
Don Wat Kao					
1	01	24	92.3	89	93.7
	25	1	3.8	1	1.1
	64-Polished, painted simple dark design	1	3.8	5	5.3
2	01	7	100	19	100
3	01	30	75.0	90	78.9
	03	1	2.5	4	3.5
	24	3	7.5	7	6.1
	25	2	5.0	5	4.4
	26	3	7.5	6	5.3
	41	1	2.5	2	1.8

TABLE XI - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
5	01	57	65.5	196	67.1
	02	1	1.1	3	1.0
	03	1	1.1	3	1.0
	20	6	6.9	19	6.5
	24	2	2.3	10	3.4
	25	8	9.2	18	6.2
	26	5	5.7	15	5.1
	27	5	5.7	22	7.5
	40	2	2.3	6	2.1
6	01	8	40.0	14	34.1
	03	2	10.0	8	19.5
	20	2	10.0	4	9.8
	24	1	5.0	3	7.3
	25	4	20.0	9	22.0
	26	2	10.0	2	4.9
	40	1	5.0	1	2.4
Don Kok					
1	01	17	77.3	35	41.7
	03	2	9.1	40	47.6
	20	2	9.1	4	4.8
	27	1	4.5	5	6.0
2	01	30	50.8	77	23.9
	03	3	3.4	4	1.2
	20	3	5.1	4	1.2
	24	18	30.5	211	65.5
	25	3	5.1	22	6.8
	26	3	5.1	4	1.2
3	01	300	45.8	1219	45.6
	02	3	.5	8	.3
	20	94	14.3	262	9.8
	24	50	7.0	209	7.8
	25	91	13.9	410	15.3
	26	90	13.7	349	13.0
	27	12	1.8	116	4.3
	40	15	2.2	100	3.7
4	01	43	78.2	60	63.8
	20	2	3.6	1	1.1
	24	1	1.8	1	1.1
	25	9	16.4	32	34.0
5	01	29	80.6	41	52.6
	20	1	2.8	1	1.3
	24	1	2.8	6	7.7
	26	2	5.5	4	5.1
	27	1	2.8	18	23.0
	40	1	2.8	4	5.1
	42-Polish over smoothed-over cordmarking	1	2.8	4	5.1

TABLE XI - continued

Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
6	01	11	21.2	54	39.1
	03	5	9.6	17	12.3
	20	6	11.5	11	8.0
	24	3	5.8	11	8.0
	25	27	51.9	45	32.6
Mixed Sherds					
Non Nong Chik					
2	01	1	8.3	3	1.8
	02	3	25.0	14	8.6
	22	3	25.0	29	17.8
	24	3	25.0	49	30.1
	27	2	16.7	68	41.7
3	01	18	42.9	370	54.7
	21	5	11.9	67	9.9
	22	7	16.7	44	6.5
	23	3	7.1	99	14.6
	24	7	16.7	76	11.2
	25	1	2.4	7	1.0
	40	1	2.4	13	1.9
4	01	6	19.4	226	13.3
	03	1	3.2	51	3.0
	21	3	9.7	18	1.1
	22	1	3.2	7	.4
	23	1	3.2	19	1.1
	24	8	25.8	51	3.0
	25	9	29.0	1258	74.3
	26	1	3.2	52	3.1
	71	1	3.2	12	.7
5	22	1	25.0	8	32.0
	24	2	50.0	14	56.0
	26	1	25.0	3	12.0
6	01	7	35.0	32	11.1
	03	1	5.0	19	6.6
	20	2	10.0	17	5.9
	25	1	5.0	16	5.6
	26	6	30.0	186	64.4
	27	2	10.0	14	4.9
	40	1	5.0	4	1.4
7	01	1	33.3	5	14.7
	26	1	33.3	2	5.9
	40	1	33.3	27	79.4

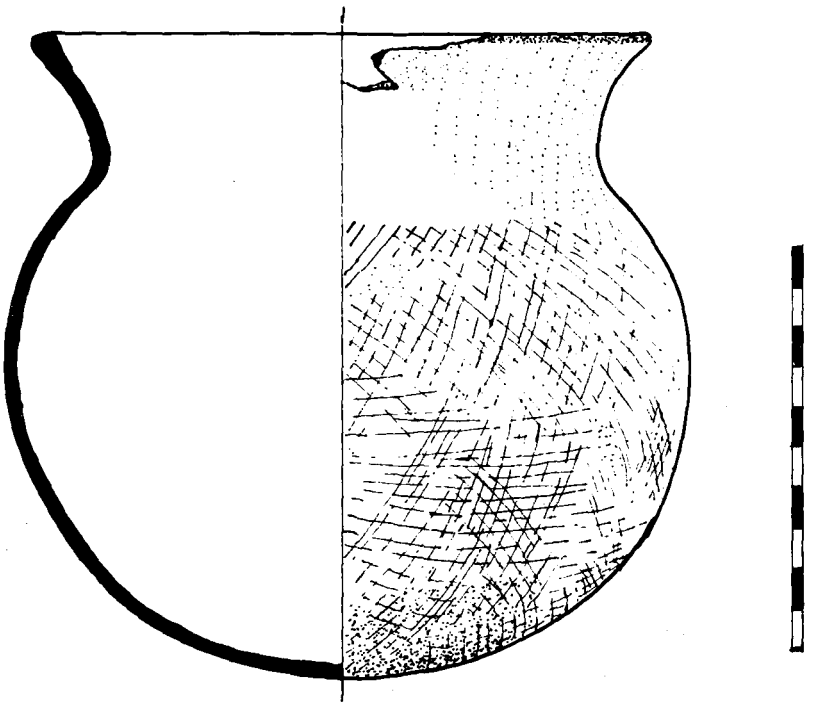
TABLE XI - continued

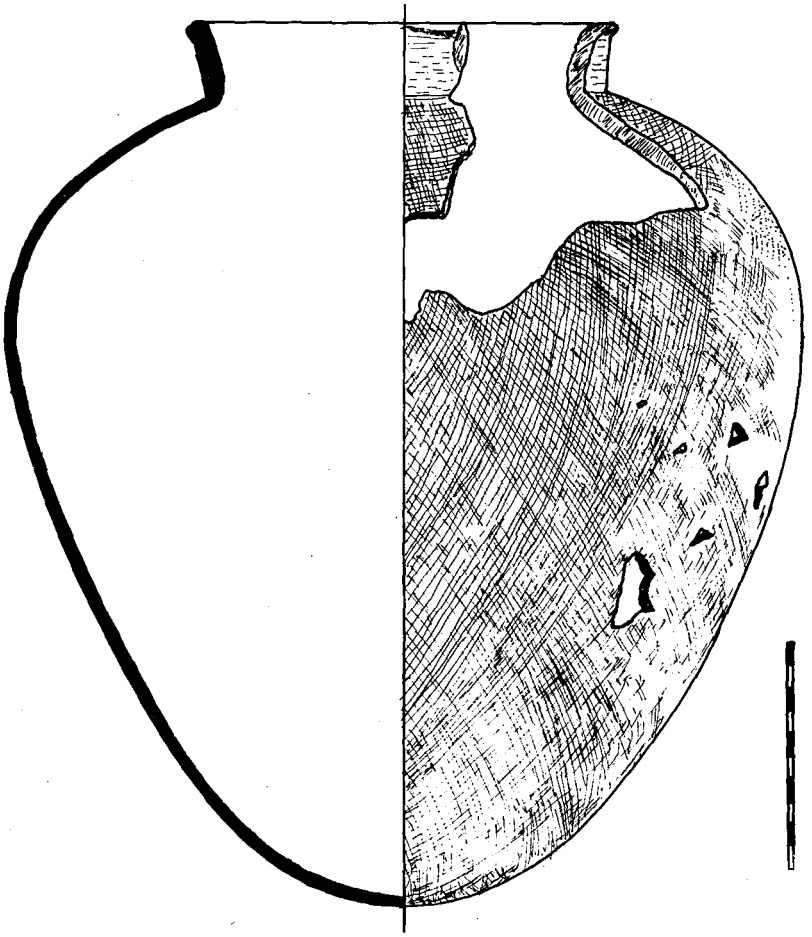
Layer	Finish	Total by number	Percentage by number	Total by weight	Percentage by weight
Don Sawan					
1	21	1	100	13	100
2	01	1	100	2	100
3	21	3	100	19	100
4	21	5	55.6	39	44.8
	22	1	11.1	12	13.8
	24	3	33.3	36	41.4
5	21	7	63.6	42	68.9
	23	1	9.1	2	3.3
	24	3	27.3	17	27.9
6	21	6	28.6	29	13.1
	22	6	28.6	60	27.0
	24	2	9.5	16	7.2
	26	6	28.6	115	51.8
	40	1	4.8	2	.9
7	22	3	23.1	18	19.8
	24	9	69.2	64	70.3
	26	1	7.7	9	9.9
8	21	2	100	75	100
10	24	1	100	14	100
12	24	2	100	7	100
Don Wat Kao					
2	01	1	100	13	100
Don Kok					
3	21	1	14.3	8	19.5
	22	2	28.6	20	48.8
	24	1	14.3	2	4.9
	26	1	14.3	2	4.9
	40	1	14.3	1	2.4
4	01	1	100	2	100
6	24	1	100	4	100

APPENDIX III :

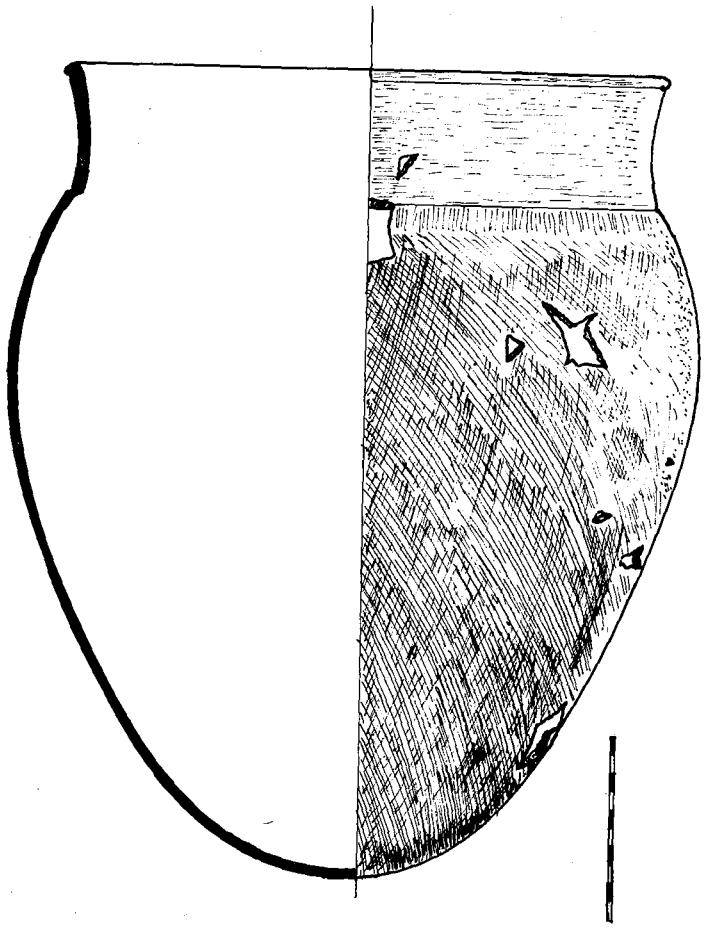
Illustrations of Reconstructed Vessels

POT 1, NNC-1



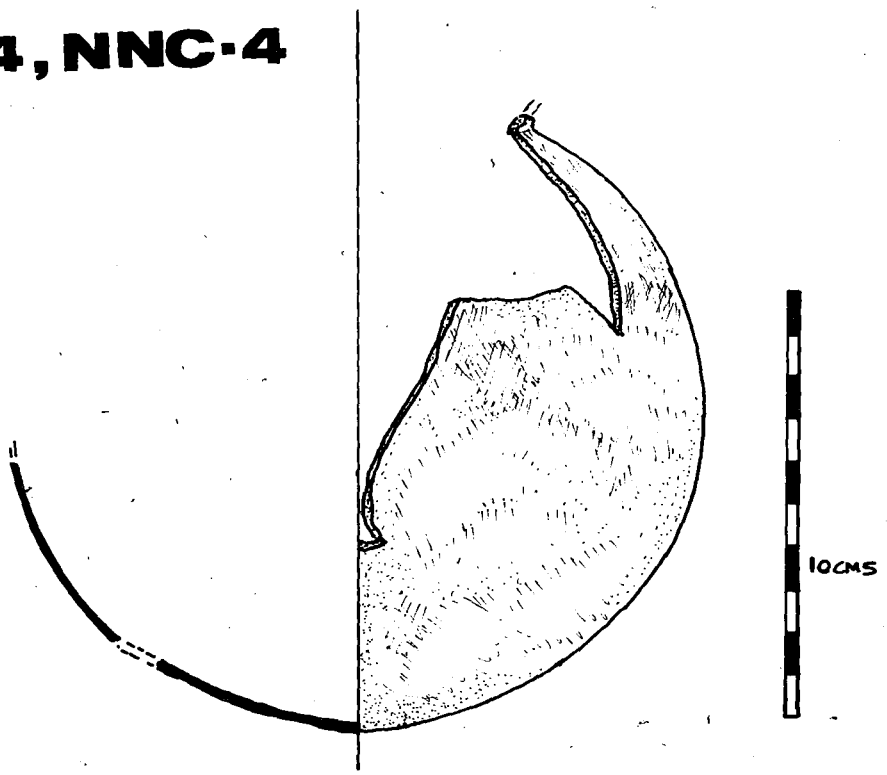


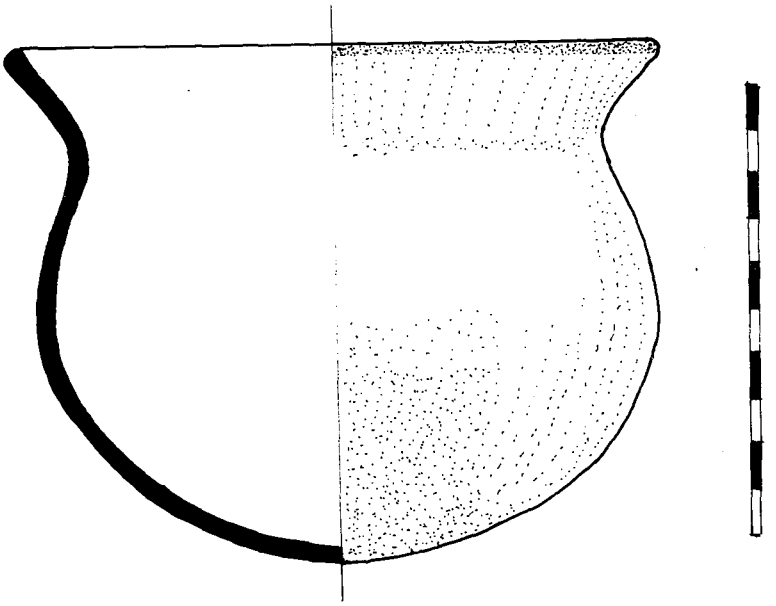
POT 2,NNC-2



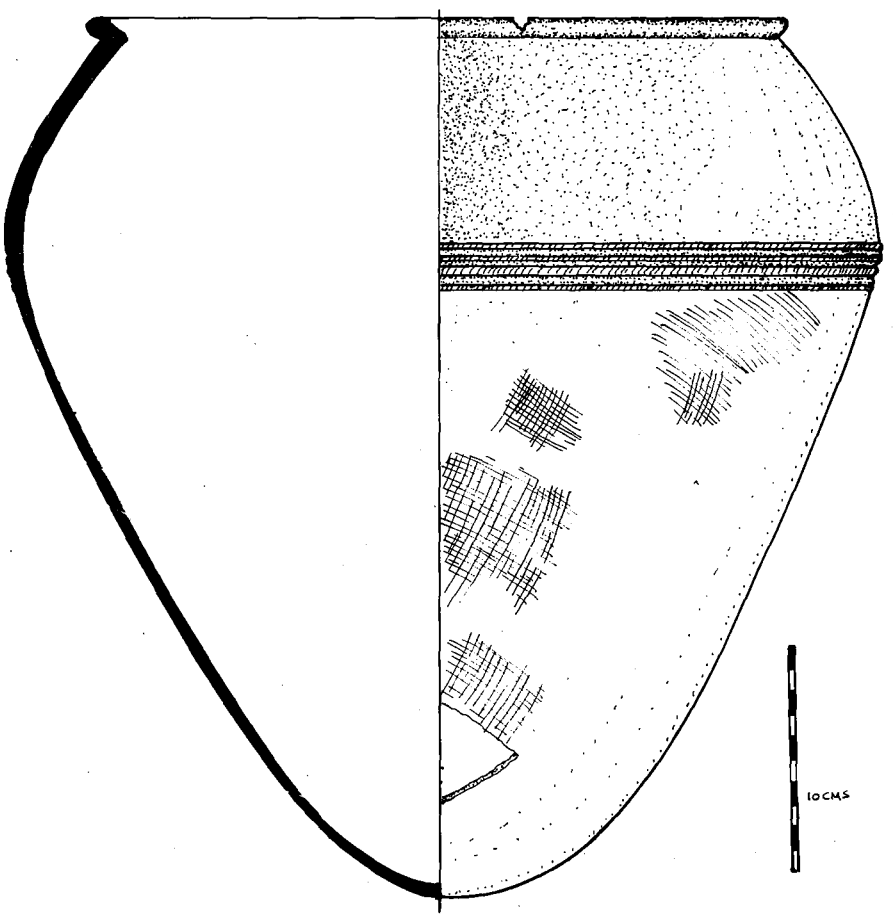
POT 3, NNC-3

POT 4, NNC-4



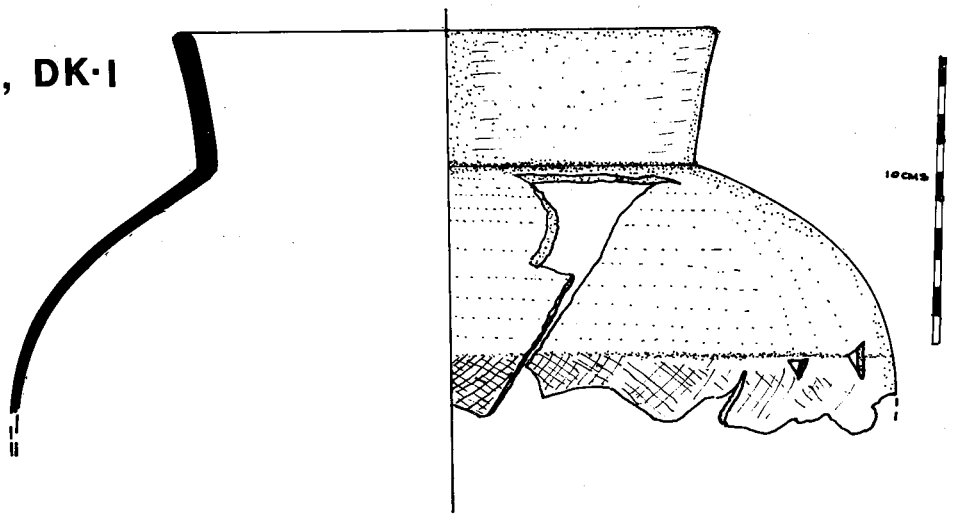


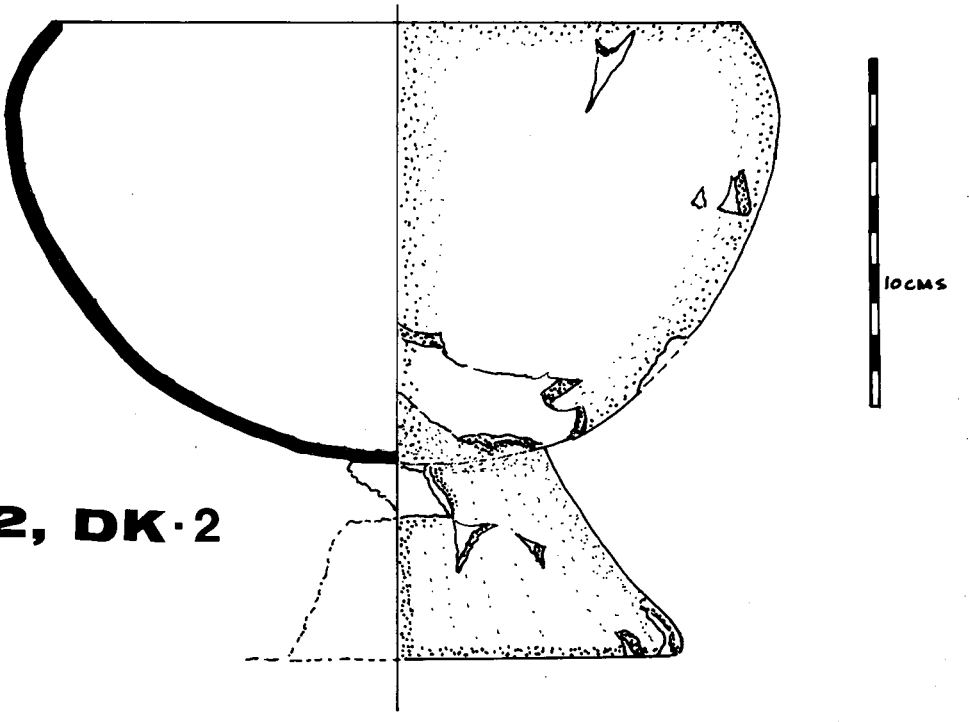
POT 5, NNC-6



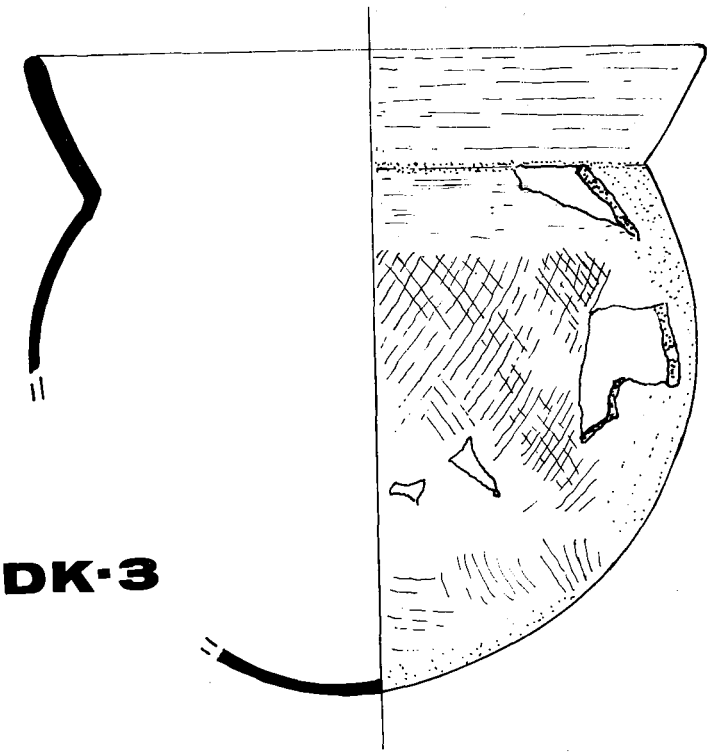
POT 6, NNC-12

POT 1, DK·1

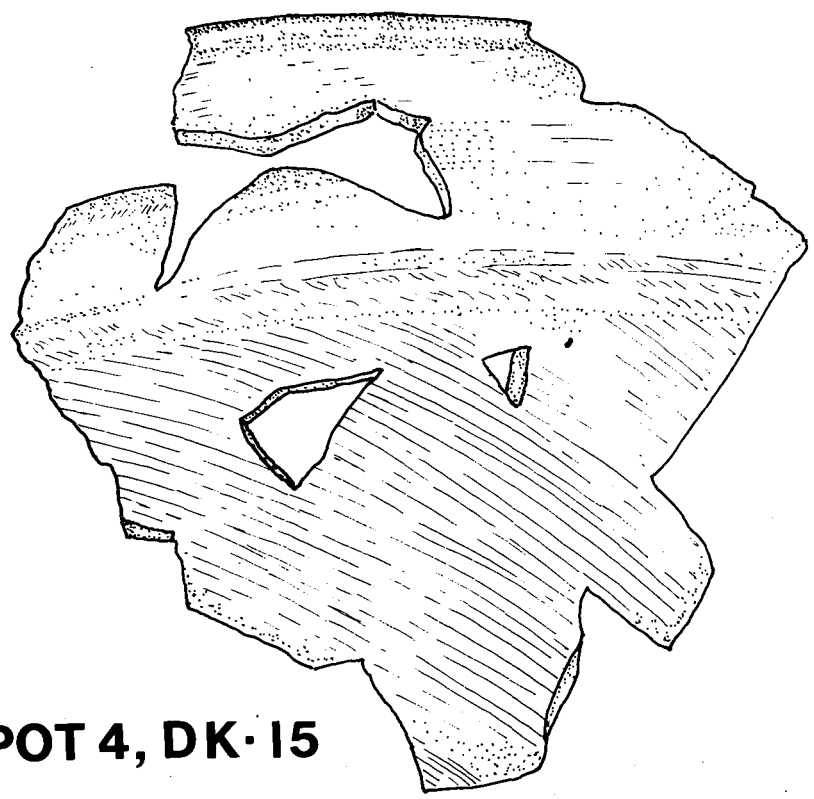




POT 2, DK·2



POT 3, DK·3



POT 4, DK·15

APPENDIX IV :

Photographs


POT 1, NNC-1
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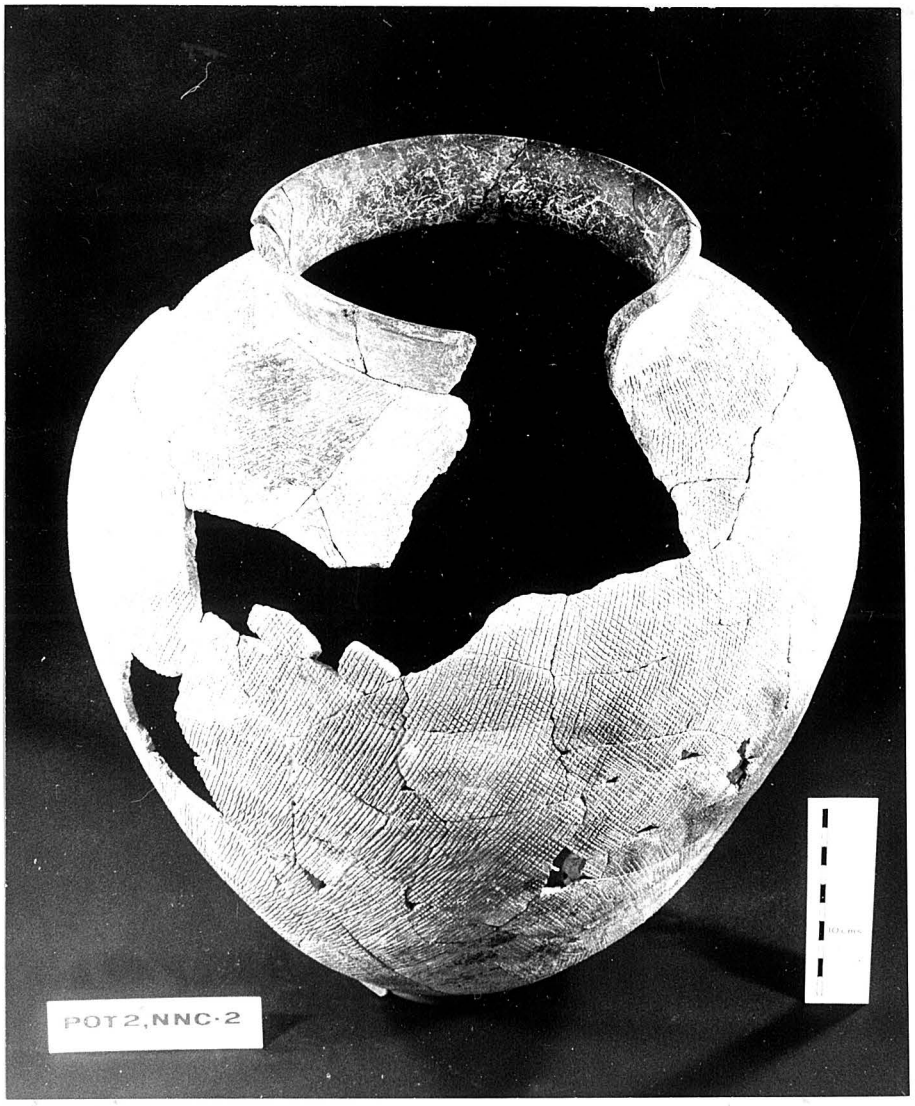
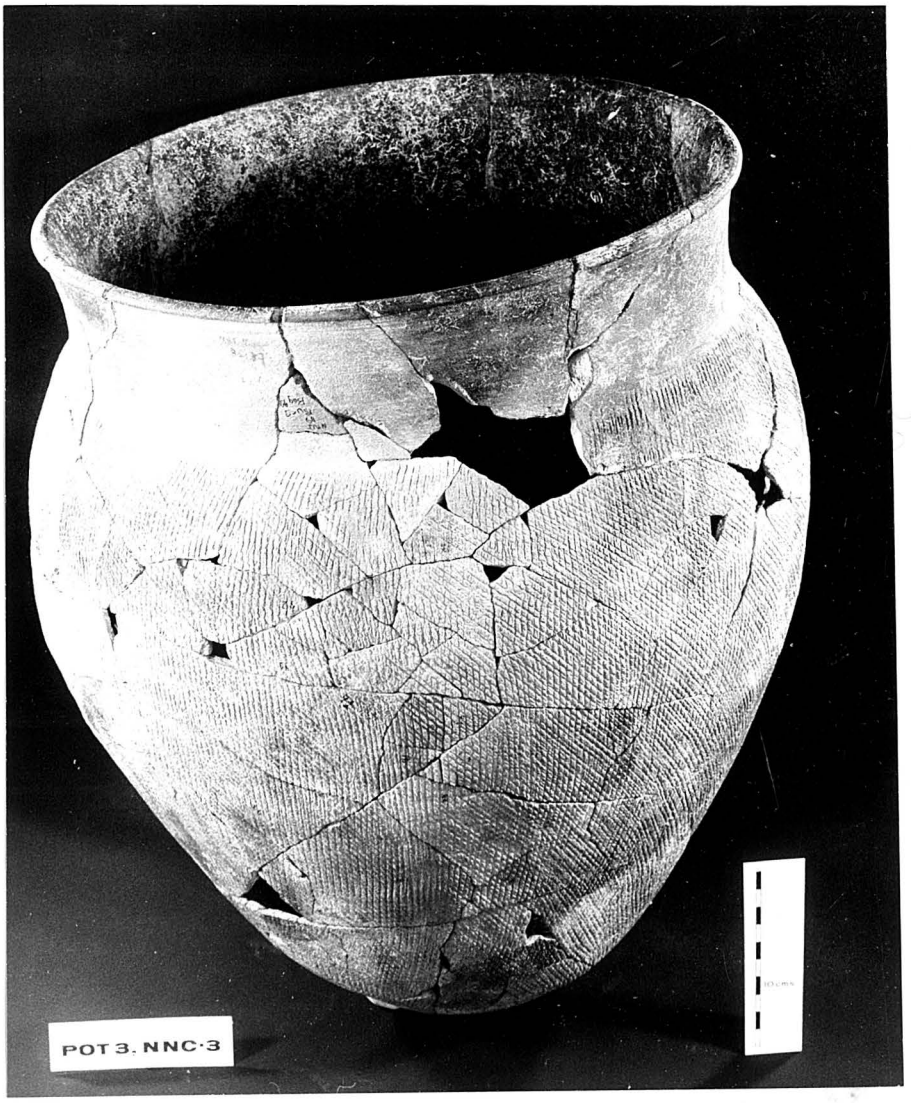
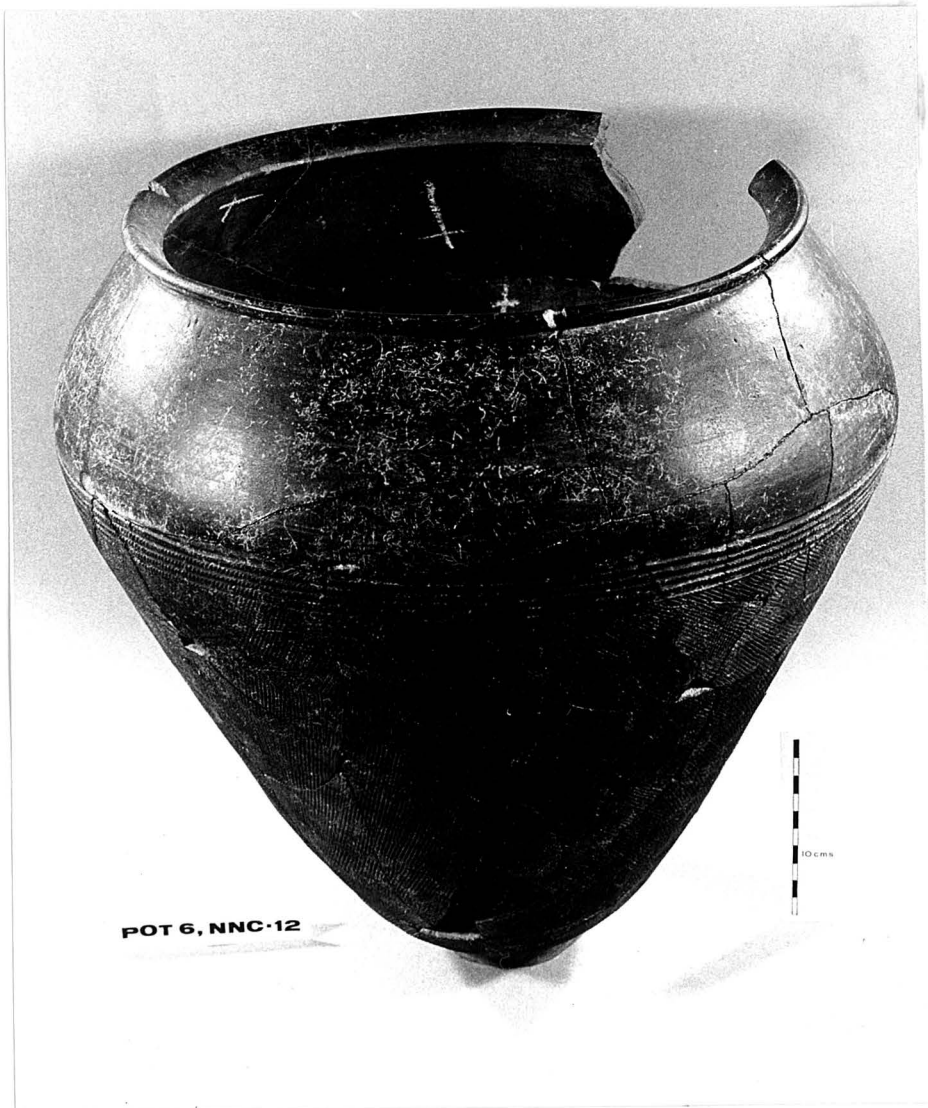
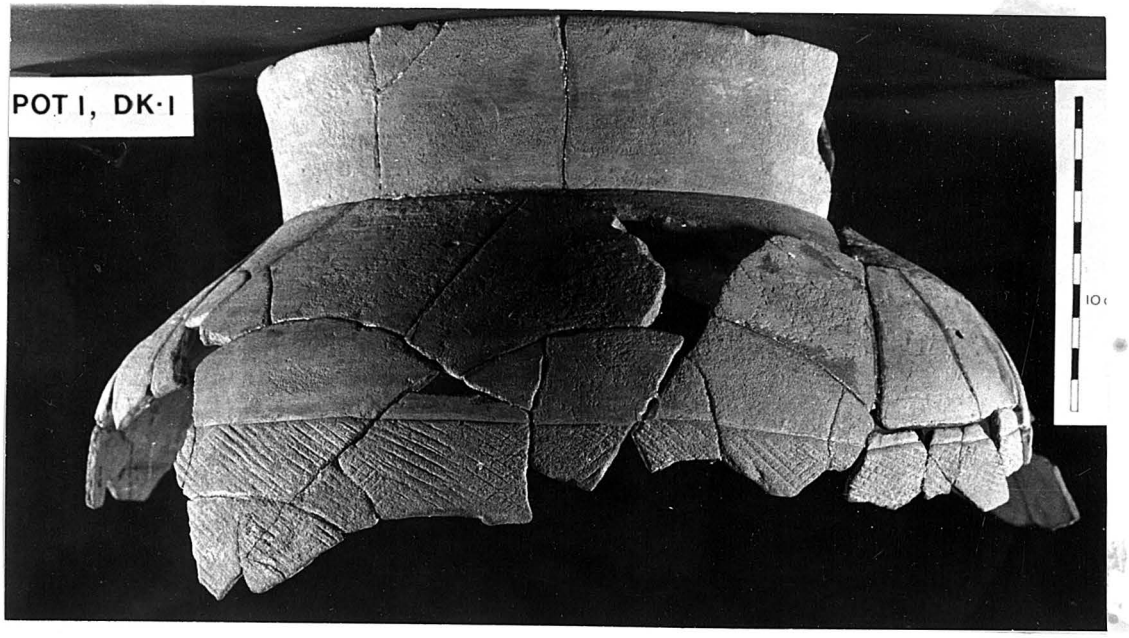

POT 2, NNC-2

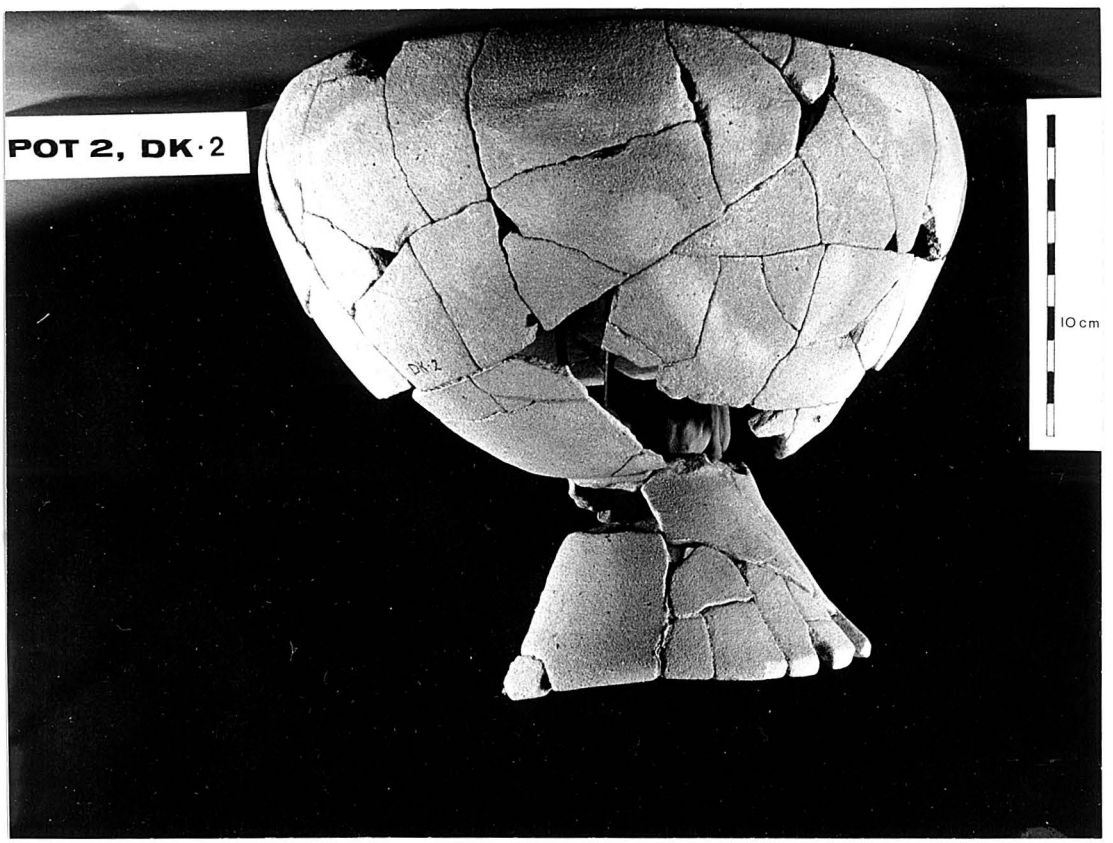

POT 3. NNC·3


POT 4, NNC·4

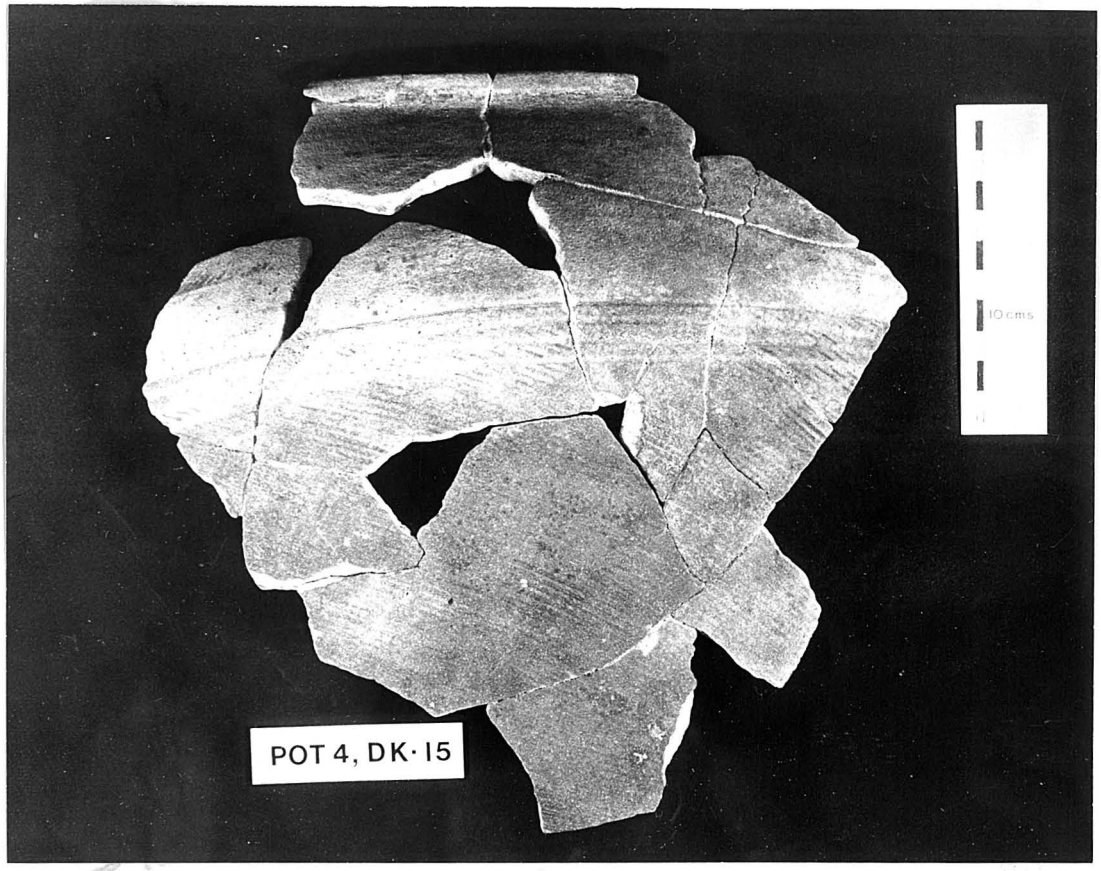

POT 5, NNC-6
10 cms


10 cms
POT 6, NNC-12


POT 1, DK·1
10


POT 2, DK·2
10 cm
DK·2


POT 3, DK·3


POT 4, DK·15
10 cms

APPENDIX V :

Computer Programme

```
12  P3..PROC OPTIONS(MAIN),.
13
14     1                P3..PROC OPTIONS(MAIN),.
15     2                   DCL FIDDLE ENTRY,.
16     3                   DCL TOTALW(100),TOTALN(100),.
17     4                   DCL HEAD(100) CHAR(20),.
18     5                   DCL CAPTION CHAR(80),.
19     6                   GET EDIT (CAPTION)(A(80)),.
20     7                   PUT EDIT(CAPTION)(SKIP(3),X(20),A),.
21     8                   GET EDIT (NCODE,IN)(2 F(5)),.
22     9                   DO I=1 TO NCODE,.
23    10                   GET EDIT (HEAD(I))(SKIP,A(20)),.
24    11                   END,.
25    12                   ISIT=6,. ILAY=1,.
26
27                      /* R.TOFL     PRIVATE S.S.L. INSERTION*/
28    14                   DCL TOFILE RECORD INPUT  DIRECT KEYED ENV(MEDIUM(SYS009,2311) F(13
29                      6) REGIONAL(1)),.
30    15                   DCL 1 TODATA,
31                            3 SKY PIC '(8)9',
32                            3 NUMBERS(16) DEC FIXED(7) INIT ((16)0),
33                            3 WEIGHTS(16) INIT ((16)0),.
34                      /*      END     PRIVATE S.S.L. INSERTION*/
35
36    16                  OPEN FILE(TOFILE),.
37    17                   ON ZERODIVIDE,.
38
39                      /* R.STFL     PRIVATE S.S.L. INSERTION*/
40    18                   DCL POFILE INPUT RECORD ENV(MEDIUM(SYS007,2311) F(3552,96)),.
41    19                   DCL 1 PODATA,
42                            2 CARDNO FIXED(5),
43                            2 POCARD,
44                              3 SITE FIXED(3),
45                              3 CAINO FIXED(5),
                                3 SQUARE CHAR(4),
                                3 LAYER FIXED(3),
                                3 SUB CHAR(1),
                                3 BURIAL FIXED(3),
                                3 PROV FIXED(1),
                                3 MATERIAL CHAR(7),
1                               3 RIM(8) FIXED(3),
2                               3 SHOLD(5) FIXED(3),
3                               3 BODY(5) FIXED(3),
4                               3 FOOT(9) FIXED(3),
5                               3 RIMFT(2) FIXED(1),
6                               3 FINIS CHAR(1),
7                               3 NOSH FIXED (3),
8
9          DOS PL/I COMPILER  360N-PL-464 CL3-9              CERAMIX          08/02/73          PAGE 0
10
11
12  P3..PROC OPTIONS(MAIN),.
13
14                              3 WAYT FIXED(5),
15                            2 SPARE(9) FIXED(1),.
16    20                   OPEN FILE (POFILE),. ON ENDFILE(POFILE) GO TO LAT,.
17    22                RAD..READ FILE (POFILE) INTO (PODATA),.
18                      /*      END     PRIVATE S.S.L. INSERTION*/
19
20    23                L99..IF ISIT  NE SITE OR ILAY NE LAYER THEN DO,.
21    24                      $KY=13*(ISIT-6)+ILAY,.
22    25                      READ FILE (TOFILE) INTO (TODATA) KEY ($KY),.
23    26                      PUT EDIT ('SITE',ISIT,'LAYER',ILAY)(SKIP(3),X(20),2(A(10),F(10
24    27                   ),X(10))),.   DO I=1 TO NCODE,.
25    28                      WEIGHTPC=TOTALW(I)*100/WEIGHTS(IN),.
26    29                      NUMBERPC=TOTALN(I)*100/NUMBERS(IN),.
27    30                   PUT EDIT (HEAD(I),'TOTAL BY NO',TOTALN(I),'% BY NO',NUMBERPC,'TOTA
28                      L BY WT',TOTALW(I),'% BY WEIGHT',WEIGHTPC)(R(F1)),.
29    31                   END,.
30    32                   PUT EDIT ('TOTAL FOR LAYER',NUMBERS(IN),WEIGHTS(IN))(R(F2)),.
31    33                      IF SITE=999 THEN GO TO FIN,.
32    34                   IF ISIT NE SITE THEN PUT PAGE,.
33    35                F1..FORMAT (SKIP,X(7),A,X(5),2 (A,F(6),X(6),A,F(8,1),X(6))),.
34    36                F2..FORMAT (SKIP,X(7),A,X(10),2 (X(11),F(6),X(27))),.
35    37                      TOTALW=0,. TOTALN=0,.
36    39                      END,.
37    40                      ISIT=SITE,. ILAY=LAYER,.
38    42                   CALL FIDDLE(PODATA,IMAT),.
39    43                   IF IMAT=999 THEN GO TO RAD,.
40    44                   TOTALW(IMAT)=TOTALW(IMAT)+WAYT,.
41    45                   TOTALN(IMAT)=TOTALN(IMAT)+NOSH,.
42    46                   GOTO RAD,.
43    47                LAT..CLOSE FILE(POFILE),.
44    48                   SITE=999,. GO TO L99,.
45    50                FIN..CLOSE FILE (TOFILE),.
```

```
CLOSE SYSIN,X'00A'
// EXEC PL/I

**APS.. ASYNCHRONOUS PRINTER SUBTASK**

1
2          DOS PL/I COMPILER  360N-PL-464 CL3-9                CERAMIX          08/02/73          PAGE 00
3
4
5                                                  O P T I O N S   L I S T
6
7*  PROCESS STMT
8
9OPTIONS TAKEN ARE LIST,SYM,XREF,ERRS,48C,OPT,STMT.
10
11         DOS PL/I COMPILER  360N-PL-464 CL3-9                CERAMIX          08/02/73          PAGE 00
12
13
14 FIDDLE..PROC(PODATA,I),.
15
16    1                FIDDLE..PROC(PODATA,I),.
17    2                    DCL 1 PODATA,
18                                2 CARDNO FIXED(5),
19                                2 POCARD,
20                                  3 SITE FIXED(3),
21                                  3 CATNO FIXED(5),
22                                  3 SQUARE CHAR(4),
23                                  3 LAYER FIXED(3),
24                                  3 SUB CHAR(1),
25                                  3 BURIAL FIXED(3),
26                                  3 PROV FIXED(1),
27                                  3 MATERIAL CHAR(7),
28                                  3 RIM(8) FIXED(3),
29                                  3 SHOLD(5) FIXED(3),
30                                  3 BODY(5) FIXED(3),
31                                  3 FOOT(9) FIXED(3),
32                                  3 RIMFT(2) FIXED(1),
33                                  3 FINIS CHAR(1),
34                                  3 NOSH FIXED (3),
35                                  3 WAYT FIXED(5),
36                                2 SPARE(9) FIXED(1),.
37    3                       I=SPARE(1),.
38    4                   L2..END FIDDLE,.
39
```

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